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Spokane River at Flood Stage

Spillway of Washington Water Power Company's Long Lake Hydroelectric Plant Passing 42,000 Sec.-Ft.

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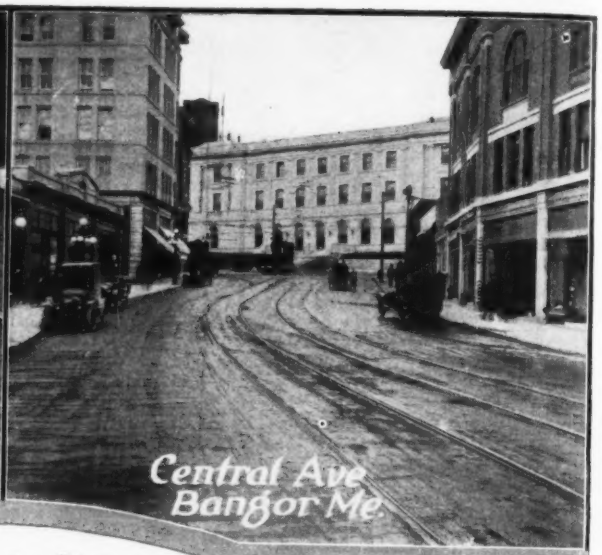

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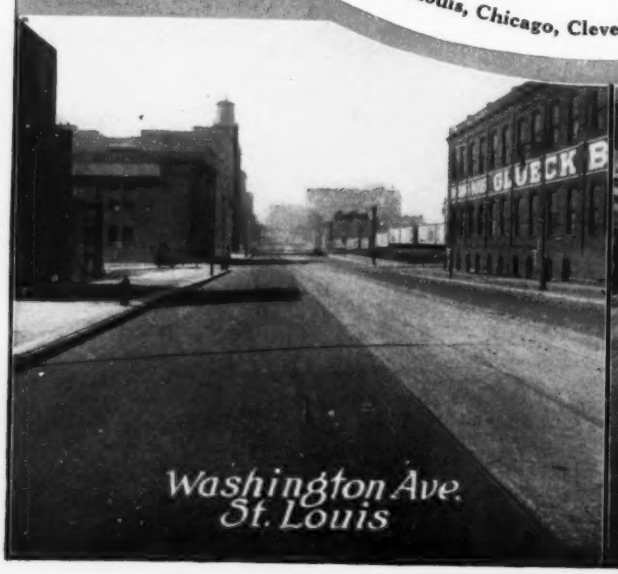

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

Volume 79 — NEW YORK, JULY 12, 1917 — Number 2

Decapitated Engineers Win in State Supreme Court

POLITICAL chicanery in Boston has been hit another blow—a blow that will hearten engineers elsewhere to stand up for their rights and for each other. The State Supreme Court has upheld the decision of the lower court that certain engineers in the Department of Public Works were not removed in good faith on Jan. 22, 1916, but under "a mere evasion of the statute." Most of the seventeen men discharged for political reasons were put back in one office or another months ago. Frank A. McInness, Bliss W. Robinson and Storrs L. Durkee, and the leaders of the engineering profession in Boston who backed them, deserve the thanks of all engineers for fighting this matter out on its merits to a successful issue. The incident affords a fine example of professional spirit and engineering coöperation.

Check Bad Manners at Conventions

IT IS much to be regretted that gentlemen lose their tempers. When, in addition, they indulge in personalities—as occurred at the sixth session of the recent American Society for Testing Materials convention—not only is nothing gained, but so thorough a basis of misunderstanding is established that the chances of progress are palpably blocked. To use the word "salesman" in an invidious manner, and in contrast to styling one's self a "testing engineer," is unpardonable. Some day chairmen not only will appreciate this and promptly insist upon a withdrawal of such remarks, but will demand an instant and complete apology, not only to the person attacked, but to the convention. If people cannot restrain themselves when angered, if they cannot comport themselves with decency and respect for their audience and opponents, they should be denied the privilege of the floor.

Mammoth Dam Failure Due to Lax State Control

THE failure of the Mammoth dam in Utah the last week in June rests in the final analysis upon the State of Utah. The legislature recognized the duty of the state to see that dams were so designed that they would not be a menace to life and property, but either the law was faulty in its provisions for enforcement of the rules it laid down or else the administrative arm of the state has woefully failed to see that the law was lived up to. The detailed report on the failure printed on page 52 shows that years ago plans for a dam at the site of the now ruined structure were filed with the state engineer and approved by him, but that the dam as built did not follow the plans. The report also shows that in 1914 other plans for this same dam were filed with the state engineer, but that those plans were never approved. It is not for us to fix the blame for such a course of events, but the present state government of Utah should lose no time in doing so and in providing against a repetition of the recent accident.

"As Usual the Innocent Were the Chief Sufferers"

SO SAYS Mr. Kleinschmidt in his report on the Mammoth dam failure, mentioned in the preceding paragraph. An irrigation company breaks the state law and engineering laws and rules of common sense and prudence. It brings heavy losses on itself but far heavier, it appears, on other companies, on various individuals and on a large section of the public deprived of railway facilities and of coal for industrial use. It is a nice question to decide what punishment should be meted out, and on whom, for these losses suffered by the innocent. Should it be money damages, and if so how much? Should there be punishment of persons, and if so how should it be distributed among officials of the company on the one hand and lax state officials on the other? Or are the people of Utah chiefly to blame for lack of sound legislation or for not holding their chosen officials responsible for the enforcement of such laws as existed? These questions are of wide interest, since Utah is by no means the only state where such accidents have happened or are likely to happen at any moment.

Waterwheel Wear May Be Determinative

THERE has been much discussion in recent years as to the relative desirability of reaction and impulse waterwheels under high heads. Two of the chief elements in the discussion are efficiency and wear. These are interdependent, of course; the initial efficiency may be seriously reduced by wear. In discussing the question at a recent convention on the Pacific Coast two installations were described which probably represent the widest extremes of wear thus far compared. One engi-

neer cited the reaction wheels in a plant where 18,500-hp. runners operate under 420-ft. effective head. The wear on these runners is so low, he said, that although the wheels have operated continuously it has been unnecessary for two years at a time to so much as open the turbine casings. Testimony of the opposite kind was furnished by the story of certain reaction runners designed to operate under 400-ft. head. After six months of operation the efficiency of these runners had dropped 60% on account of excessive wear. Obviously then, making sure of the qualities of the water may be fundamentally important. Whether or not the water is found to be free from particles in suspension, the design of the runners must be correct if erosion is to be prevented; and in addition there is the possibility of chemical effect. This chemical danger may be rare, but in a case fully reported elsewhere in this issue it caused the shutdown of a waterpower plant. Hydraulic engineers may need to make studies in water chemistry before selecting their power-plant wheels.

Should the Interstate Commerce Commission Be Remodeled?

DOES the Interstate Commerce Commission need a thorough overhauling? Three times in the last six years, as the *Railway Age Gazette* pointed out last week, the commission has had before it applications for general freight-rate increases. Each time it has denied them, on the ground that prospects were not so bad as pictured by the railroads. After both of the other decisions, in 1911 and in 1914, conditions did prove as serious as the railroads had predicted. The situation was aggravated this year, in the case just decided, by two facts—that we are in an emergency and need all the help we can get from the railroads, and that the opposition to increases, so strong hitherto, was wavering. Yet five of the six living commissioners failed to take the broad view urged by the sixth.

Better things, in times gone by, have been looked for and obtained from some of the able men who constitute the commission. Does the academic spirit now pervade the commission's sanctum to such an extent that its members lose the faculty of taking a large view of the whole railroad problem? Railroad development has been backward for several years, backward because railroad credit has been poor. This condition is not merely a future possibility, to be warded off in due time if things become as bad as the railroads predict. It is a fact and has been for five years, and business has suffered.

The country needs a commission that will set diligently to work to remedy the situation, even at the risk of giving the railroads a shade too much in case of doubt. The railroads cannot undertake comprehensive development of terminals, trackage and equipment on the strength of a few months of abnormal business, and that comprehensive development is needed more than ever before. The emergency is here, and the Interstate Commerce Commission must meet it or give way to a reorganization.

Despite Camp Impressions the Army Does Need Engineers

IN INDIA, at least in the India of the young Kipling, "single men in barracks don't grow into plaster saints." In this day and country, what with the Y. M. C. A., and the movie, and the bone-dry law, the single men are not likely to be the cause of trouble. It is the married man with his visions of family neglected and business disrupted who becomes the problem of the training camp, though his morals be above suspicion. It is one of this class whose letter, which is printed on another page of this issue, is the cause of the explanation of the Government's use for engineers in the war. To such a man camp life has no appeal. Singing by chorus is only an occasional relaxation of his college reunion, and the constant company of men obviously and joyously a dozen years his junior becomes decidedly uncongenial. His nerves fray under the gregariousness of camp life, and his mind soon seeks explanation of methods and manners which to the younger man are all a part of the new game and as such do not require explanation.

It would be unfortunate if any considerable number of engineers, either in training for commissions in the Engineers Reserve of the new army or contemplating such training, were to get themselves into the state of mind indicated by the letter, because it seems so apparent that the correspondent's complaint, partly explainable by temperamental difficulties which are to be expected, is also due to lack of information with which he should have been supplied, and which incidentally it is the purpose of the explanation printed in this issue to furnish.

Criticisms of the Government's methods of training its temporary military engineers are permissible, though it must be said that no one has such expert knowledge of how such training should be conducted as the officers of the army themselves. The fact remains that the Government will have pressing need for engineers of all sorts in the campaign which inevitably lies ahead of the army in France. Mistakes will undoubtedly occur and individuals will probably suffer from neglect and mistreatment, for the War Department today is probably the busiest organization in the whole world. Busy and, what is more, hastily enlarged organizations are bound to make mistakes, but the department is doing its best to sort out the engineering talent offered it so that each man will fit into his proper niche.

The department has announced that it wants all kinds of engineers. It remains, then, for those who have volunteered and who do not seem to be fitted to their proper place, to take up direct with Washington, through proper military channels, of course, where they are parts of military organizations, their disposition for future use. Once their preliminary, and to the military mind necessary, training is accomplished, they may be sure that their talents will be disposed of to the best use of the Government.

What Is Delaying the Fabricated - Steel Ships?

The plans have been ready for many days, but General Goethals is still waiting for authority to let contracts for vessels to be built with structural shapes. The decision as to policy is overdue. Construction must start.

FOR many days the plans for rapidly building ships of structural steel have been ready, but we hear of no contracts for them being let. The steel ships ordered are of the older types. On the other hand, there has been a revival of the strange stories about wooden ships, which would be amusing if the shipping situation were not so serious. Yet the situation is of elementary simplicity.

Wooden steamships have been built in large numbers in this country, but not large ships for transatlantic service capable of sufficient speed for the present requirements. This is not saying such ships cannot be built; they can be. When the first large wooden ships were designed to meet the present emergency, investigation showed that they would not have sufficient torsional strength. Two were built in Canada. Before they sailed, they developed weakness; they never reached port and their fate is unknown. No useful purpose was served in sending such ships to sea. Proper designs were prepared, and about 210 wooden ships are being built for the Government. They will be found seaworthy, if constructed honestly.

These wooden ships are of little value except for emergency use. They are very costly per ton of cargo capacity and will be very costly in operation. As means of meeting an emergency they are justifiable, if nothing better can be found. That the need for them is not yet serious in the eyes of Great Britain is shown by the fact that shipyards in eastern Canada, able to build these ships, receive no orders from the British authorities and have been asking for American contracts, although every yard in any part of the world that will take a British order for a steel ship can get it instantly. This common talk about Great Britain building wooden ships if the United States does not is misleading; a few wooden ships are under construction for British service in the Pacific, but the British authorities know well that the wooden ships are practically worthless for transatlantic use except under emergency conditions, which they manifestly consider are not imminent or they would have ordered such ships from the Canadian yards ready to build them.

The energetic publicity in favor of wooden-ship building lays great stress on an alleged dearth of steel and an abundance of lumber. Such statements are so misleading as to deserve the strongest condemnation. An hour's ride from Washington, at Quantico, Va., the construction of marine barracks has been delayed by inability to secure prompt deliveries of low grades of lumber much less difficult to obtain than the clear stuff required in shipbuilding. Although the Coöperative Committee on Lumber of the Advisory Commission of the Council of National Defense has been in existence for months, there are difficulties in obtaining lumber for Government work just as trying as those in obtaining other supplies. The only difference between the lumber and steel situations today seems to be that the executive departments at Washington have not yet stopped contracting for lumber in order to discuss prices, as they have stopped contracts for steelwork. Just why the building of wooden ships of an experimental nature at exorbitant prices at any terms the builder proposed has been considered good business policy and building steel ships at very moderate prices and of demonstrated serviceability has been called bad business is beyond our insight.

General Goethals was ordered to Washington some months ago to build ships. It was a wise appointment, because the American people had confidence in him. They knew that, although the Panama Canal cost far more than it was originally estimated to cost, this was due to the unexpectedly great extent of the work. The unit costs, the prices per cubic yard of excavation and such items, were within the estimates of the International Commission of Consulting Engineers which fixed the general plan for that undertaking. Before he was appointed as the nation's shipbuilder, it was common talk that there were very fine contracts to be had for wooden ships; and the wail that went up shortly after he took charge and stopped some of them is proof of the truth of this rumor. Since he has been in Washington, he has developed plans for good wooden ships and let contracts for them. They will be built rapidly. But he has also let contracts for as many steel ships as builders will undertake, which will also be built rapidly and are worth far more than wooden ships, and has been waiting for authority to build steel ships with structural shapes, which will be equally as good as the standard type and can also be built rapidly. These steel ships will be good for something five years hence, while the wooden ships will be of little value.

General Goethals is popularly regarded as the greatest builder in the country, an economical builder; but if his method for the simultaneous rapid and economical building of the best types of wooden and steel ships does not appeal to the administration, it ought to permit him to retire again to private life, where his services are in great demand. What he has tried to do was to build as quickly as possible at reasonable prices all the steel ships the American yards can produce and as many wooden ships in addition as are needed to make up the fleet required to meet existing conditions. The former plan was to build nothing but wooden ships of an untried type, not approved by some experienced naval architects, of no value after the war, and so experimental in their nature that, in spite of all rumors to the contrary, nobody was willing to build them under any satisfactory guarantee as to their efficiency.

Defiance of Statute and Engineering Law Wrecked Mammoth Dam

Original Plans and Specifications Approved by State Engineer Not Followed—Too High Water Level Under Makeshift Conditions of Construction and Operation

By H. S. KLEINSCHMIDT
Consulting Engineer, Salt Lake, Utah

THE failure of the Mammoth reservoir dam in Utah on June 24 and 25, resulting in the loss of the structure and a large volume of water stored for irrigation and in large property and other losses to the Denver & Rio Grande R.R., coal-mining companies and others, was due to violation of state legislation that resulted in makeshift construction. It was also due to careless operation.

The Mammoth reservoir is owned by the Price River Irrigation Co. It is located in the central part of Utah, in the Wasatch Mountains, six miles west of Scofield. Its altitude is 8500 ft. The watershed is about 20 square miles, reaching an altitude of 9750 ft. The reservoir held about 11,000 acre-feet of water at the time of failure. The stored water was used to supplement the low-water flow of Price River during the summer, for the irrigation of lands southwest of Price.

The average annual precipitation at Scofield, at an altitude of 7500 ft., is between 18 and 19 in. Snow frequently lies to a depth of 10 ft. on the level in this region at the end of the snowfall season in April.

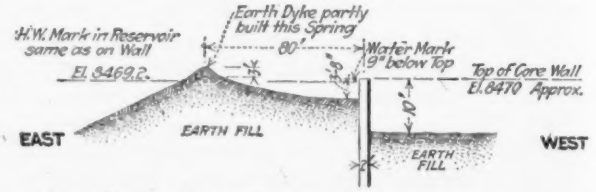
The dam was an earth-fill structure, with a concrete heart wall founded on bedrock, exposed in the stream bed and sides of the canyon. Bedrock is sandstone lying in strata sloping slightly downstream. Between the strata is either shale or clay.

The original plans and specifications, filed some years ago, and approved by the state engineer, had not been followed in any particular. After work had progressed along entirely different lines in violation of the state law requiring the approval of plans for dams still other plans were filed in the office of the state engineer, but the revised plans have never been approved.

Dam Raised Piecemeal from Time to Time

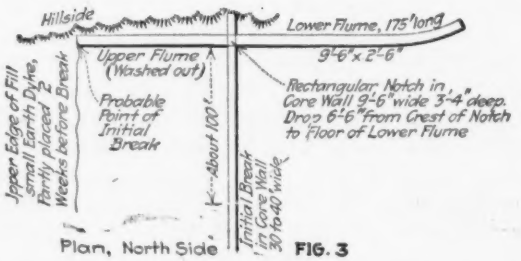
At the time of failure, the dam had been built to an elevation of about 70 ft. above stream bed. It was 160 ft. wide on top, with a concrete heart wall along the axis. The top of the earth-fill on the downstream side of the wall was at an elevation 10 ft. below the top of the wall, and on the upstream side 3½ to 4 ft. below the top of the wall. The fill on the upstream side of the wall sloped upward from the wall to an elevation the same as the top of the wall at a point 80 ft. distant, where a narrow dike of earth had been thrown up with crest 3 ft. above the top of the wall. Part of this dike was built about two weeks before the failure. The dam had been raised from time to time to meet the demands as the project on which the stored water was used developed. The last raise, of 5 ft., was made in the fall of 1916, at which time the heart wall and the earth-fill on the upstream side of the wall were raised. The fill on the downstream side of the wall had not been raised. The lower portion of the fill had been sluiced in, the remainder having been placed by wagons and scrapers and compacted with a heavy corrugated-iron roller.

The earth composing the fill is a clay loam. Some parts of the fill remaining show a very dense hard fill,



Cross-Section, East-West Near South End of Dam

FIG. 2


Hillside
Lower Flume, 175' long
Upper Flume (Washed out)
3'-6" x 2'-6"
Upper Edge of Fill small Earth Dyke, partly placed 2 Weeks before Break
Probable Point of Initial Break
Rectangular Notch in Core Wall 9'-6" wide 3'-4" deep. Drop 6'-6" from Crest of Notch to Floor of Lower Flume
about 100'
Initial Break in Core Wall 30 to 40' wide

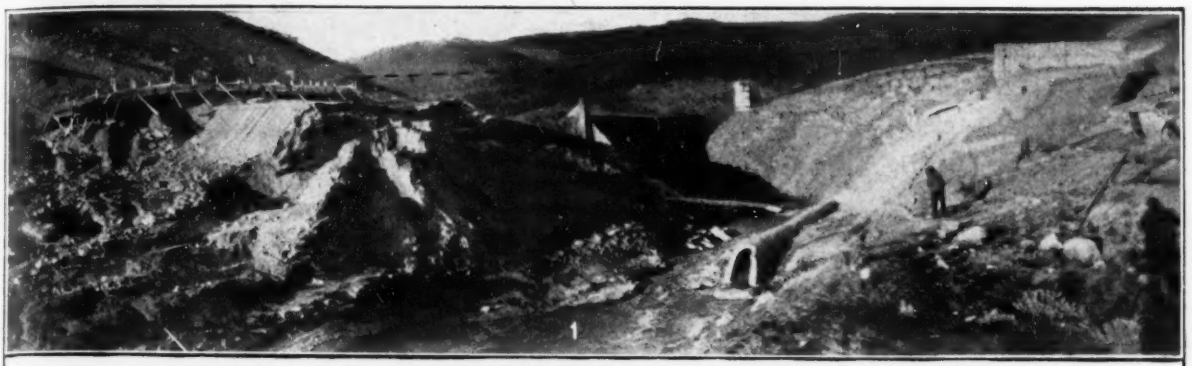
Plan, North Side FIG. 3

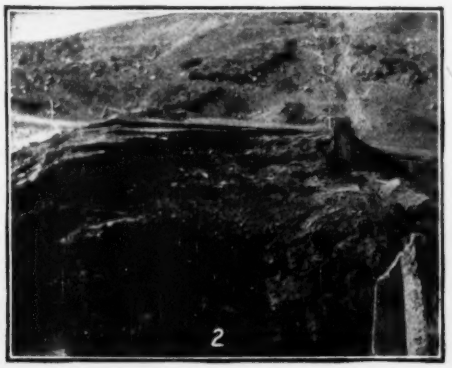
SKETCHES VISUALIZE THE CAUSES OF FAILURE

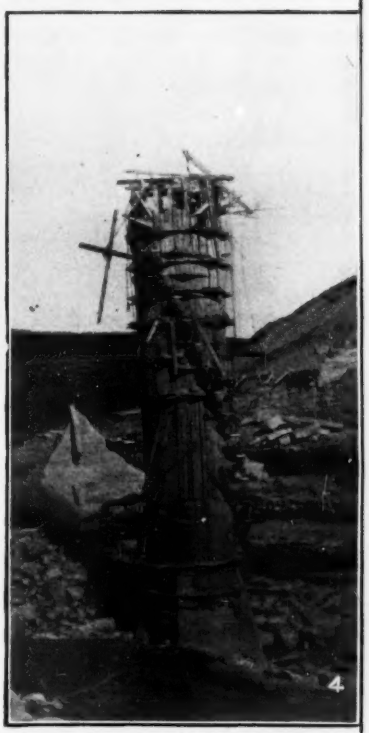
Relative levels of water in reservoir, heart wall, earth embankment above and below heart wall at time of break are shown in section and location of flume and initial break in plan

but the major portion shows the earth to lack cohesion, being very friable, having broken off and slipped during and after the washout as though only recently placed, fractured parts being very loose and crumbly.

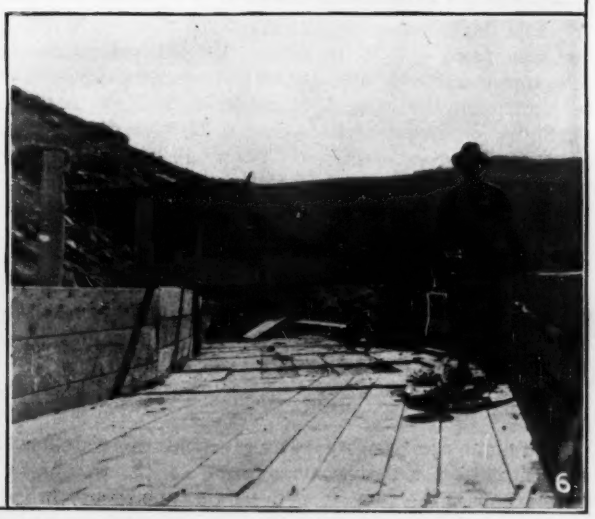
The concrete heart wall was founded on bedrock, was joined to bedrock on both abutments and was about 450 t. long. It was 2 ft. thick, buttressed at intervals of 25 ft. on both faces. The buttresses were 2 ft. thick, 2 ft. long at the elevation to which the heart wall had been completed, sloping to 9 ft. long at the base. They were without reinforcement and were not tied by reinforcement to the wall or foundation. The plans call for vertical reinforcement of the heart wall near the upstream face with horizontal reinforcement also. Standing portions of the wall show ½- and ⅝-in. rods vertically at the center of the wall projecting above the top of the wall. One portion of the base also shows similar rods, and horizontal rods up to an elevation 12 ft. above the base, but none above. Some broken pieces show no reinforcement whatever. It appears, therefore, that







1. LOOKING AT RUINED DAM FROM BELOW
2. LOOKING SOUTH ALONG DAM AND HEART-WALL
3. TIPS OF MAN'S FINGERS ARE AT WATER MARK ON HEART-WALL
4. UNFINISHED OUTLET TOWER STANDS UNHARMED
5. REINFORCEMENT SHOWN IN SECTION OF HEART-WALL ADDED IN 1916
6. LOOKING EAST THROUGH LOWER PORTION OF FLUME



STORY OF THE FAILURE OF THE MAMMOTH RESERVOIR DAM IN UTAH, AS TOLD BY THE CAMERA

the plans were not carefully followed. Intended for a seepage cutoff wall, its design, and more especially its construction, made it depend almost entirely upon the support of the earth-fill on either side for stability.

Small Makeshift Wood Flume for Spillway

No permanent spillway had been built. On the north side a wooden flume 9½ ft. wide and 2½ ft. deep was built along the junction of the fill and the hillside. This butted against the lower side of the heart wall, in which a rectangular notch of about the same dimensions was left. When the addition of 5 ft. to the heart wall was made in 1916, the flume on the downstream side of the wall was left in place, so that there was a drop from the crest of the notch to the floor of the flume of 6½ ft. On the upstream side of the heart wall a similar flume was built extending to the upper edge of the fill and terminating in the small earth dike. The floor of this flume at its upper, or east, end is said to have been from 4 to 5 ft. below the crest of the earth dike. No wing walls or cutoff walls had been built. The floor rested on mudsills, and the sides were supported by timbers that had been driven into the fill. Three 6-in. plank flashboards had been put in at the head of the flume, and water was being held 14 in. above the floor of the flume, or, according to the caretaker, 3 ft. below the top of the earth dike. No water was flowing through the flume, the inflow into the reservoir being handled through the outlet tower.

Incomplete Outlet Tower Proved Useless

The outlet tower is circular, 6 ft. inside diameter, of reinforced concrete. It is provided with four 12-in. inside diameter mud sluices at the bottom, with gates operated by screw lifts from the top of the tower. Eighteen one-fourth bend cast-iron inlets 12 in. inside diameter are located in a spiral around the tower. Their openings point upward, with round cast-iron covers, operated each independently by chains, cables or ropes from the top of the tower. No foot-bridge or adequate operating platform had been built, access being had by means of a lumber raft. The top of the tower had not been carried up as high as water was being held in the reservoir, the caretaker stating that water was from 4 to 5 ft. above the finished concrete. The tower connects with an arched concrete outlet culvert through the dam, 5 ft. wide, 4 ft. high to arch springing line, the arch having a 2½-ft. radius. The tower and culvert remained intact, about one-half of the culvert being exposed on its lower end. Two of the mud sluices and three of the inlets near the top of the dam were open. Lumber forms projected above the top of the concrete at the top of the tower, and on top of this was a mass of timbers to which the pulleys carrying the ropes and cables for operating the inlets to the tower were fastened. Some water was finding its way through the forms into the tower.

Watchman's and Caretaker's Accounts of Break

The history of the break, as given by the watchman and caretaker, is that at noon, June 24, the watchman being alone at the dam, everything was apparently in its usual condition, and water in the reservoir had not risen in the previous 24 hours. The watchman went to dinner about ¾ mile away, remaining 2 to 2½ hours. On his return, water was flowing through the earth dike at the upper end of the dam, at the north side, southwesterly across the earth-fill and out through a gap in the concrete heart wall, 30 to 40 ft. wide, which had broken out about 100 ft. south of the north end of the dam. This section appeared to have broken off to a depth of about 5 ft., probably along last year's junction plane.

It is the writer's opinion that this assumption is not correct. It is impossible that less than 4 ft. of water could have caused the breaking off of the wall at a depth of 5 ft. The break must have occurred near the level of the top of the earth-fill on the downstream side of the wall.

No Help at Hand

The watchman immediately summoned help by telephone, but the remoteness of the dam prevented any assistance arriving in time to be of use. It is certain that, under the conditions that prevailed, no human agency could have saved the dam. When the caretaker arrived by horseback about two hours after being notified, he made his way on the raft to the outlet tower and attempted to tear away the wooden forms projecting above the concrete, so as to allow a greater flow of water into the tower. He was only partly successful. The various ropes and cables for opening the inlets to the tower could not be operated, and there was nothing to be done but watch the dam crumble away. The rush of water through the break washed out the fill on the downstream side of the wall, and with it from time to time sections of the wall, until finally, more than 24 hours later, the main break occurred and the major portion of the water was released.

Probable Cause of the Dam Failure

Evidence and testimony point to the break having occurred in one way only, as follows: Water found its way around or under the upper end of the flume, which had not been properly bedded and protected in the earth dike at the upper end of the fill. This water filled the depression between the dike and the heart wall. Water marks on the upstream face of the heart wall show 9 in. below the top on the south end and 7 in. below the top at the north end. This mark corresponds to the high-water mark of the reservoir on the slopes above the dam. This water saturated the earth-fill sufficiently to overturn or push out by sliding a portion of the heart wall. Scour marks on the earth-fill under the lower flume just below the heart wall show that water pouring through the notch had deeply scoured the fill. This may have been a contributing cause to the failure of the heart wall.

Early reports laid the break to an unusual volume of water from melting snow entering the reservoir. This cannot have been the cause. The watchman's testimony is that the reservoir level had remained stationary for 24 hours previous to the break, and the high-water mark in the reservoir shows that the upper dike was not overtopped. Neither had there been any wind to scour out the fill.

It is also reported that there was a stream of about ½ sec.-ft. volume issuing from the hillside about mid-height of the dam, just below the lower end of the lower

flume, which ceased after the destruction of the dam. This was reported a week after the break and after the writer's examination. This is given no weight as connected with the failure of the dam except that if water from the reservoir was finding its way around the north end of the dam, it may have partly saturated the fill on the upstream side of the heart wall and helped cause overturning of the wall.

The disaster can be attributed only to utter carelessness in the lack of an adequate spillway and in the flimsy construction of what was intended for a spillway, together with the unsafe height to which water was held in the reservoir against the earth-fill forming the crest of the earth dam.

The unfinished condition and design of the outlet tower formed a contributing cause. The very temporary makeshift provisions for controlling the inlets to the tower made it impossible to operate them. In opening, it is necessary to lift the full weight of the water standing over the covers to unseat them. This, with the arrangements at hand, made it impossible to open any but those near the top in any event. The caretaker also states that, when several of these outlets have been opened, the water falling into the tower creates such an excessive vibration that it is considered dangerous to open any more. This feature had been commented on previously in a report to the state engineer on the adequacy of the construction. Thus, the tower afforded no means in an emergency of letting out quickly a large volume. This is not the function of such an outlet, but a set of several large gates near the bottom of the tower with screw-lift stems and an operating platform adequate and easy of access would have afforded this extra emergency outlet.

Had the spillway been deep and wide enough, properly protected, with means for the quick removal of the flashboards, the calamity would most certainly not have happened. A spillway 20 ft. wide, 4 ft. deep, with floor 10 ft. below the crest of the fill, should have been provided.

Damage to Denver & Rio Grande Railroad

Water from the reservoir joins the Price River about 20 miles below the dam at Colton. Between this point and Hale, 11 miles above, the Scofield branch of the Denver & Rio Grande R.R. was entirely destroyed. From Colton to Helper many miles of the main line were destroyed, practically all bridges being wholly or partly washed out. At Castle Gate the depot was washed away. The bottom of Price Canyon is thickly lined with houses near the various towns, mostly homes of coal miners. There was ample warning of the impending disaster after the initial break, and they were able to move all their effects. Otherwise, a very heavy loss of life would have resulted. As it was, only one death occurred, that of a young woman sightseer whose automobile backed into the flood.

TWO OF THE DENVER & RIO GRANDE RAILROAD BRIDGES HIT BY THE FLOOD WATERS FROM MAMMOTH DAM FAILURE

These were 85-ft. bridges. The east pier of one was washed out and of the other cracked and twisted from foundations when flood cut a new river channel

Coal Mines Shut Down and Industries Threatened

The destruction of the railroad caused the practical shutdown of all the coal mines in the district, which is the leading coal-producing section of the West, the Denver & Rio Grande R.R. being the only outlet. Unless a very speedy opening of the road is effected, a coal shortage will shut down all the large industries of the state, since the amount in storage is estimated at less than two weeks' supply. This feature is particularly unfortunate. The shortage of cars for various reasons has rendered it impossible for the railroad to supply even the summer demand for coal in some sections; and in addition it had been hoped to store large quantities during the summer to guard against a repetition of last winter's experience, when unusually severe weather and other conditions made it

impossible for small users and outlying communities to obtain coal at all.

The loss to crops to be served from the reservoir is problematical. The diversion dam for turning water from the Price River into the canals is intact. The natural flow of the river will be greater than usual this summer on account of the snow which still lies in considerable amounts on the mountain watersheds. This, with offers of water from other sources, makes the outlook favorable for no great crop loss.

Railroad officials hope to have the road open for nominal traffic by the middle of July, but it will take many months to get the railroad in good shape.

ELOQUENT WARNING AGAINST LAX OPERATING METHODS

The disaster is an eloquent warning against lax methods in the operation of structures that at best have elements of danger against which every possible precaution should be taken. State officials all over the United States should renew and increase their vigilance and insist that the laws governing the construction and operation of reservoir dams be rigidly enforced. The Price River Irrigation Co., at whose door the failure must be laid, is the least loser. The innocent parties, as usual, are the chief sufferers.

The examination on which this report is based was made in company with George F. McGonagle, state engineer of Utah, and J. L. Rhead, of the state engineer's office. The writer acknowledges assistance rendered by them, including photographs and drawings furnished.

City Planning Commission Proposed

A City Planning Commission for Cincinnati, Ohio, has been provided by the Charter Commission in one of its sections for a proposed new city charter. The Planning Commission is to consist of seven members, and the charter provides an annual appropriation of $30,000 for the years 1918, 1919 and 1920, and thereafter appropriation of funds is to be made by the council. The powers and duties of the commission will be to make plans and maps of the whole or any part of the city, or any land outside of the city which bears a relation to the general planning scheme of the city. The maps and plans are to show the recommendations of the commission for new streets, alleys, viaducts, bridges, subways, parkways, playgrounds and any other public grounds or public improvements, also the removal, relocation, widening or extension of existing public works. Power is also given the commission to control, preserve and care for historical landmarks and decide upon the location of works of art and statuary belonging to the city.

Mineral Water and Barometric Levels Synchronize at Saratoga Springs

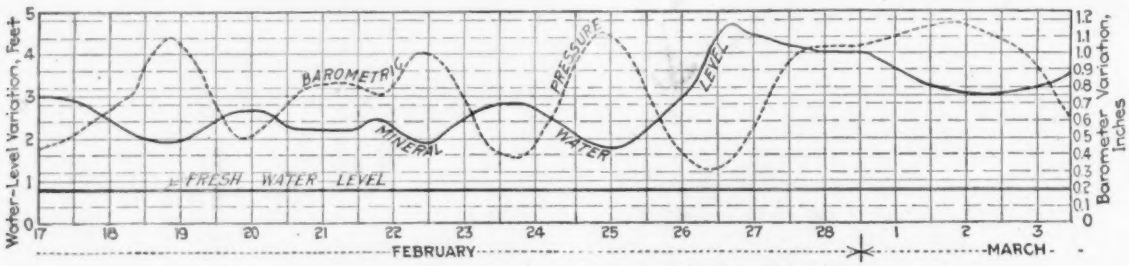
BY CHARLES G. ANTHONY
Chief Engineer, Saratoga Springs Reservation

OF PARTICULAR interest to hydraulic engineers is the dual water system underlying the City of Saratoga Springs, one a reservoir of pure soft water, the other a reservoir of strongly carbonated mineral water.

The state geologist has shown the following section of the strata at Saratoga Springs, from above downward: 75 ft. drift sand and gravel; 25 ft. clay; 100 ft. gravel; 300 ft. shales and slate; 500 ft. limestone; 400 ft. sandstone; ancient gneiss and metamorphic rock.

Above the clay the pure soft water is found, while below the clay the mineral water is found—weak mineral water in the shales, strong mineral water in the limestones and sandstones.

There are 122 mineral springs and wells on the state reservation, ranging in depths from 125 to 1006 ft.



LEVEL OF SARATOGA SPRINGS MINERAL WELLS FLUCTUATES WITH BAROMETER

These wells all extend below the clay and all yield mineral water of varying mineralization.

Above the clay 75 wells were opened ranging in depth from 20 to 40 ft., all yielding pure sweet water. As the reservation contains 540 acres, we have one well on every 2½ acres of land or an ideal system of bore holes from which to study the two water systems.

The mineral water comes to the surface with a temperature of between 50 and 54° F. (10 to 12° deg. C). It is interesting to note that the temperatures are appreciably higher in the summer than in the winter, the waters being 2° F. warmer in August than in April. The specific gravity of the water will vary with the amount of dissolved solids, ranging from a minimum of 1.0034 to a maximum of 1.0123.

The waters are alkaline saline, or saline, and nearly all contain enough iron to be classed as chalybeate. The mineral waters are all naturally carbonated, the average rate of CO_2 gas to water being about 4½ to 1. There is a constant stream of mineralized water flowing from the southwest to the northeast. It is a current of living water, gathering strength as it flows slowly through the rocks, until with its vitalizing charge of carbon dioxide gas it issues clear and sparkling to the surface. This reservoir of mineral water follows none of the laws of percolating waters. Its movement is entirely independent of the fresh percolatory water above. It is not uncommon to see the mineral-water horizon rise while the fresh-water horizon lowers. Sometimes the two horizons move in synchronism, but always the movement of the mineral-water horizon is many times greater than that of the fresh-water horizon.

The peculiar ebb and flow of the mineral-water system, while noticed for years, has never been satisfactorily explained until recently. Many observers attribute the ebb and flow to the attraction of the moon. It was noticed by men operating the natural carbonic acid gas plants that invariably greater quantities of gas were received in the gasometer whenever there was a south wind blowing.

The curves on page 56, showing mineral-water level, fresh-water level and barometric pressures, prove conclusively that the fluctuation or rise and fall in the mineral-water level is due to barometric pressure alone. The solubility of carbonic acid gas varies directly as the pressure up to about six atmospheres pressure, when the law ceases to hold. A high barometric pressure holds a given quantity of gas in solution. A low barometric pressure releases a given quantity of gas and permits it to appear as a bubble where it occupies space and immediately displays an equal volume of water and causes the mineral-water level to rise. An increased barometric pressure drives this gas back into solution where it occupies no volume, the bubble disappears and the mineral-water levels falls.

It is seen from the curve that the fresh-water level shows no variation over a period of two weeks, while the mineral water shows a fluctuation of 2.8 feet.

A Letter Answered:

Does the Army Need Engineers as Officers?

This is the case of a candidate for a commission in the Engineer Officers' Reserve Corps who has become discouraged at the outlook, as viewed from the barracks of a training camp. His statement that "there is no apparent use for the experienced engineer in the Army Corps of Engineers" is one which should not be allowed to pass without comment. *Engineering News-Record* quotes below the main portions of the letter from its correspondent and presents, in rebuttal, a discussion based upon information secured from an authoritative source. Brief editorial comment appears on another page.

A LETTER from an engineer in training for a commission in the Engineer Reserve Corps of the Army, received by *Engineering News-Record,* is a complaint, good natured enough in places, but nevertheless a complaint that the prospects of his being of service to his country in the capacity for which he was urged to volunteer are very small. This journal has been able to maintain close contact with the development of the military situation as it affects engineers and takes this opportunity to describe the present situation as it sees it, and to dispel misapprehension into which the correspondent, typical of many others, has been led.

Impressions of Camp

The important extracts from the letter follow:

"Sir—I am a volunteer in training for an officer's commission, Engineer Corps, United States Army, in a Far Western camp. I am a middle-aged man, with wife and children dependent upon me; an engineer in a specialized line, with extended experience and able to handle men—qualifications pointed out by the recruiting circulars as most important for those applying for commissions. My income in civil life supported my family in comfort, but not in excessive luxury. In other words, my entering the service entailed considerable financial sacrifice. On points aside from money, I have had to leave my family, in a manner, to the tender mercies of friends and the less tender advice of relatives.

"In joining, I intended to apply for a captaincy. I found, however, that the Government, when making the examinations, had candidates agree to an appointment of next lower rank than that aimed at, if the desired rank could not be obtained. To put it frankly, it was impossible for me to support my family on the salary of a first lieutenant. I was willing to give all of my time and experience to the Government at a captain's pay, but I could not see my way clear to do it for less. Therefore, I applied for a majority, hoping to get a captaincy.

"*I came into the service as a duty, and because I thought, from the circulars urging engineers to join the officers' training corps, that my experience might help.* I find in the camp a number of other engineers, well known in the profession, of moderate incomes but uncommon ability, who, like myself, have sacrificed much in order to 'do their bit.'

"A few days ago, we were pleasantly surprised by having a regular-army instructor tell us that all commissions already given, and the rank applied for, meant nothing. On completion of our course of training, the Government would consider everything, and even those with reserve commissions might expect to be reduced in rank.

"Now there were some in the engineering division who were seriously affected by this news. One able engineer stated frankly that in offering his services he had applied for a commission where his income would support his family, that anything less than this was impossible; and that, if he had to take a chance of a subordinate position, it would be best for him to withdraw at once. This he has done.

No Use for the Experienced Engineer

"But to return to the main point, which is that there is no apparent use for the experienced engineer in the Army Corps of Engineers. There you have it. 'Engineer' in civil life means one thing. 'Engineer' in military life has only one similarity to it. It is spelled the same. They do not need experienced engineers in the Engineering Corps.

"Of course, we were old enough so that we should have investigated more thoroughly. When the call went out, 'Uncle Sam needs experienced engineers!' we ungrammatically said, 'That's me!' jumped up and said, 'Present, Uncle!' and here we are. We should have inquired whether he wanted electrical engineers, hoisting engineers, civil engineers, stationary engineers, or what breed. The fact is that engineers are not needed in 'The Engineers' except for ranks of major or better, and we have enough prospective majors and generals in this one camp to beat the world. I say with absolute conviction that, for the ranks of second lieutenant, for lieutenant and captain, a first-class labor foreman is the proper man. He may not shine as brightly as a college graduate when he gets to Piccadilly or the Champs Elysées, but I conceive of this war as a great big contract—a 'job,' not a society event.

"Now please, Mr. Editor, do not get the idea that we are quitters, that we hesitate to dig trenches under fire, that powder explosions make us faint. We will go through hell for Uncle Sam if he can use us for the purposes for which he called us—as engineers. But in justice to those who may join in the future, why not let the technical men of the country know that the word 'engineer' in the army means nothing at all like what it means in civil life? Why not endeavor, with your great influence, to get jobs for engineers where engineers are needed?"

Two Points of Complaint

There are two distinct points of complaint in the letter: (1) The volunteers are apt to be offered lower positions than those for which they applied; (2) experienced engineers are not wanted in military work. Authoritative replies to both points may be made as follows:

In regard to possible reduction in rank, the correspondent is entirely misinformed. The War Department's policy at the time of the opening of the camps was as follows, and this policy is still in force:

A. Reserve Engineer Officers, actually commissioned, were ordered to the camps with the grade of their commission.

B. Those who had passed a local board and had been recommended to the War Department for commission by the Chief of Engineers were requested to attend the camps and were informed that their commissions would be issued as soon as possible and that upon acceptance of them they would be ordered to active duty in the grade in which commissioned.

C. Men who had passed a local board, but whose papers had not yet been acted upon by the Chief of Engineers, were requested to attend the camps and were informed that, if their application was approved by the Chief of Engineers, they would be commissioned and ordered to active duty as soon as possible.

There are a few men at each camp whose applications were made so late as to prevent any local examination. These men were admitted with the express proviso that their prospective rank would be affected by their proved qualities in camp; but those men rated by an examining board will be given the recommended rank unless they show decided disqualifications, in which case they probably will not be commissioned at all. No commissions once given will be revoked except for cause, nor will reductions in rank be made. It is quite possible, however, that defects in temperament, ability or aptitude disclosed in camp may be so great as to lead the department not to assign an already commissioned man to active duty, or at least to hold him in reserve until something to fit his qualifications develops.

Two Classes of Officers

In regard to the correspondent's second point, it is necessary first to explain that Engineer Reserve Officers have been classified as A and B. The intention of these classifications is to discriminate between service combatant troops—namely, the pioneer regiment attached to infantry divisions (Class A)—and the wide field of engineering activity carried on in the rear of the fighting troops (Class B).

This second service comprises two classes, service with line-of-communication troops, and engineering staff duty at the base and on lines of communication. Service with troops may be with railway-operating regiments, railway-construction and maintenance-of-way regiments, railway shop organization, roadbuilding battalions, second-line fortification battalions, topographical sections, water-supply units, logging and lumbering units, building-construction units or work companies, made up of common labor. For service abroad all such engineer organizations will be formed on a military basis, the men being enlisted and uniformed, and it is absolutely necessary that the engineers in charge of the work to be performed by them should have as thorough a knowledge of military methods as can possibly be given them in the short time available. They must know how to maneuver their commands in moving from place to place, to entrain them and detrain them in an orderly manner, to make and break camp, and to requisition and obtain equipment and supplies.

The engineering staff duty will consist largely in superintending the work of several units or in the making of special investigations and reports for general headquarters and in inspection of engineering work.

The work of line-of-communication units may take them into the areas immediately behind the armies, and they are not entirely free from the dangers of campaign.

The War Department has waived minor physical defects in the cases of applicants desiring Class B service, but has endeavored to recommend only those who are reasonably fit for field service.

It is realized that there are at training camps some very able engineers in special lines of work, who, either by experience or temperament, are unfitted for duty with troops, but who will be of the greatest service on special staff duty. It is the intention of the department to make every possible use of such men in their special fields.

Field Organization

Our forces in France will consist of men in the trenches and in the zone of advance engaged in active fighting, but behind these men there will be a fanlike formation reaching back to the ports where land all supplies and men. This vast fan will be one of the greatest engineering organizations on earth, comprising railways, both large and small, roads, water transport, water-supply, electric-light and power lines, factories,

warehouses, everything in fact that in peace comes under the expert supervision of the civilian engineer. All of this organization must be manned by army men, and it is mainly for the officering of such commands that the Engineer Officers' Reserve is being formed. The members of this corps will serve as the reservoir from which the many diverse jobs behind the lines must be filled. There will be a place for nearly every kind of engineer, for there will be nearly every kind of work.

Scope of Instruction

It is the function of the training camp to instruct the prospective officer in the rudiments of purely military engineering—in the duties of both the line and the engineer troops at the firing line—partly because, if the war lasts, many of these men will take up that work, but mainly to give them some idea of military discipline and organization, since they must become a part of such an organization. By far the greater number of the reserve engineer officers, however, will be assigned to duties compatible with their talents and civil-life training.

For the direction of such work by military units, obviously the engineer and not the labor foreman will be needed in the grade of lieutenant and above. The labor foreman's military place is the counterpart of his old place in civil life—as the highly important noncommissioned officer all the way from the corporal to top sergeant and master engineer. It is considered essential that all the officers in this new corps of engineers should have some intimate contact with and knowledge of military life and methods. In no way are the common soldiers' burdens better learned than in the first six weeks of work laid out in our training camps. In no way is the necessity better seen for careful discharge of administrative duties by company officers in order that the men may be properly housed and fed, kept well and contented.

It seems clear to this journal that the misapprehension of our correspondent is due, in part, to the very evident lack of acquaintance with the details of our military functions, in part to the fact that the officers' training camp was in its introductory stage when the letter was written, and in part to a lack of tact on the part of the instructors in presenting some phases of the work. It is hoped that the explanations given will clear the minds of any men already in or contemplating entering a training camp for engineer officers.

Reforesting Water-Supply Land on Catskill System

Advantages of Reforesting Outlined—Available Varieties Named—Over 2,000,000 Conifers Planted Around Ashokan and Kensico Reservoirs

By Fred F. Moore
Designing Engineer, Board of Water-Supply, City of New York

FORESTRY, more particularly reforestation of denuded areas, offers a profitable and pleasant field of endeavor to those responsible for our public water-supplies. The sponge of a few inches to a foot or more in depth on the surface of forest lands steadies the run-off and prevents turbidity and the silting of reservoirs from soil erosion. Temperature and air movement, two factors having a strong influence upon evaporation, are also affected favorably by forests. Forest trees, as a whole, take up much less water than cultivated crops, including grass lands. It has been estimated that conifers take up only one-tenth as much as deciduous trees. The mat of needles under an evergreen growth keeps frost out of the ground and permits penetration of rain water.

Best Trees for Watersheds

Conifer trees are by far the best cover for water-supply areas. An evergreen forest makes a pleasing picture at all seasons, and there are varieties of these trees well adapted to most situations and conditions. Until very recently the white pine has been a great favorite for general planting, as it has a pleasing habit of growth and adapts itself to wide variations of soil condition. The white and other five-leaved pines have recently been seriously attacked by the so-called "blister rust," a fungus bark disease whose host is the black current and gooseberry. To control this situation, New York and near-by states have passed, or are contemplating, legislation prohibiting the propagation of white and other five-leaved pines.

THESE CONIFERS AT THE ASHOKAN RESERVOIR WERE NATURAL SEEDLINGS TRANSPLANTED INTO AND CULTIVATED IN THE BOARD'S NURSERY BEFORE BEING PLACED IN FINAL POSITION

The red pine is a good substitute for the white and is valuable for general planting. It is picturesque even on poor soils, and on richer soils it has a vigorous and superb growth of long, deep-green needles. Scotch pine adapts itself readily to many soils and will withstand severe wind exposure, but should not be planted in the shade. Austrian pine, a hardy, rapid grower, adapted to exposed positions and poor soils, has particularly effective plumes of heavy branches. Pitch pine and bull pine are also useful varieties of the pine group. Norway spruce (the spruce of Europe) is a very rapid grower, extremely hardy, can be planted in the shade and is well adapted to exposed positions. The native white spruce, an attractive tree, has also proved especially valuable for watershed planting, as it is

hardy and adapts itself to both wet and dry soils. Colorado blue spruce, the bluest of the white or blue spruces, which gives a rare tint in color combinations and furnishes a strong contrast with the darker evergreens, is one of the hardiest of the spruces. Concolor fir, second only to Colorado blue spruce for color contrasts, adapts itself to many soils and exposures. Arbor vitæ is particularly useful for close hedge planting on reservoir margins near the high-water line, as, when so employed, it will prevent the leaves of deciduous growths from blowing into the water. Hemlock, attractive at all seasons, particularly good for ornamental planting in conspicuous locations, is hardy and will thrive in the shade.

Reforestation Along Catskill Aqueduct

In connection with reforestation the Board of Water-Supply of the City of New York has planted more than two million small conifers around and near the Ashokan and Kensico reservoirs, besides many thousands of trees in ornamental planting along the Catskill Aqueduct and on other lands. This work has been done partly by contract and partly by the board's own forces. The situation at this time with reference to the Ashokan reservoir lands is about as follows:

	Acres	Total Acres
Open land, forest planted by contract	500	.....
Open land, forest planted by board	375	.....
Open land yet to be improved	225	1,100
Standing forest underplanted	100	.....
Standing forest improved	3,000	.....
Standing forest yet to be improved	1,800	4,900
Forest lands		6,000
Open land, including highways, railroad, etc.		754
Total land area		6,754
Area of water surface at flow line of Ashokan reservoir		8,500
Total taking		15,254

The present forest land is covered with so-called second-growth white oak, rock oak, red maple, sugar maple, hemlock and white pine. The chestnut growth is being removed on account of mortality from fungus diseases. Plantings have been for the most part of Norway spruce, arbor vitæ and of Scotch, red, white, Austrian, jack and bull pines.

907 Acres Planted at Kensico

At the Kensico reservoir 907 acres have been planted, of which about 400 were by contract. Of the total, 170 acres are underplantings of existing forest growths.

For the most part these plantings have been made with three- and four-year-old stock, spaced about 6 ft. apart each way. This requires about 1250 transplants per acre. The cost of the transplants in place is from $25 to $50 per acre, depending upon local conditions.

With minor exceptions, plantings by the board's forces have been of transplants raised in its own nurseries, either from seed or from seedlings obtained from the State Conservation Commission and from commercial nurseries. Excellent stock has thus been obtained, which is immediately available at all times when plantings may be done. The establishment of nurseries may be justified whenever areas to be covered are at all extensive and suitable soil and other conditions are obtainable.

Charles Strauss is president of the Board of Water-Supply. Charles N. Chadwick and John F. Galvin are the other two commissioners. J. Waldo Smith is chief engineer.

Materials and Tests

Abstracts of Papers Presented at the Convention of the American Society for Testing Materials, June 26 to 29

THE following abstracts of papers presented at the twentieth annual meeting of the American Society for Testing Materials, June 26 to 29, supplement those published last week:

Can the Properties of Steel Products Be Determined by Magnetic Analysis?

A group of investigators has for some years been working on the possibility of establishing an exact correspondence between the magnetic and mechanical properties of steel. Among these, Charles W. Burrows, United States Bureau of Standards, has taken a leading part. In a paper entitled "Some Applications of Magnetic Analysis to the Study of Steel Products," Mr. Burrows outlines the present state of knowledge regarding these investigations. He outlines some of the actual accomplishments toward the solution of the problem of commercially testing steel by magnetic methods.

The principle involved is that many, if not all, of the mechanical properties of steel are directly proportional to certain other magnetic qualities. Mr. Burrows says the "art of magnetic analysis consists in the determination of the magnetic characteristics, or better, a small number of magnetic characteristics, and from these observations making estimations of the mechanical properties." It can be seen that if this can be worked out practically there is a great field for commercial testing. Routine tests are now made on actual samples, and the sample is, as a rule, destroyed. Such tests, Mr. Burrows says, are vicarious, destructive, local and qualitative. These include the mechanical, chemical and microscopic analyses of steel which form the basis for customary specifications in testing. If large-sized pieces of metal can be investigated magnetically and the mechanical properties determined thereby, there is a great saving in effort and time and material. Mr. Burrows outlines some of the detailed methods of making the tests and notes that this work has been carried on in the investigation of rails and tools, particularly of razor blades. He is very hopeful of the future of the tests.

Preliminary Tests of Heat-Insulating Properties and Fire-Resistive Material

The United States Bureau of Standards is about to make tests on the fire-resistive properties of structural units. As a preliminary to these tests, the bureau has recently completed some experiments on the conductivity and heat-insulating properties of certain materials generally used in fire-resistive construction. These tests were reported by W. A. Hull, of the bureau. The tests were made on 8 x 16-in. cylinders of different materials, which were placed in a furnace and subjected to temperatures running up to 927° C. in 1½ hours and kept there for 2 hours, giving an exposure of 3½ hours at an average temperature of approximately 700° C. These cylinders were perforated with holes at different distances from the surface, so that the penetration of heat could be read by thermocouples.

Tests were made on clay, such as is used in the manufacture of hollow-tile fireproofing; concrete, including two proportions of a number of aggregates; gypsums, including three manufacturers' specimens prepared from mixtures differing in kind of filler and in ratio of plaster to water, one specimen of lime mortar and one specimen of some unnamed new material. The results, as stated by Mr. Hull, are in brief as follows:

The tests indicate that there is not a very great difference, among concretes from the aggregates commonly used, in respect to the protection that would be afforded to steel reinforcement embedded in concrete near the surface, assuming that the concrete protection does not come off and expose the reinforcement. It would not be wise to draw conclusions on that point from this work. As to protection of steel members, the insulating properties of the denser clays are indicated to be inferior to the more porous clays and to the concrete. It is to be noted in this connection that this work deals exclusively with solid materials, and it is not attempted to draw comparisons between hollow blocks or tile of one material and the solid mass of another. The more porous clays compare fairly well with the concrete. Gravel concrete gives particularly unfavorable indications, following in general the theory laid down by Ira H. Woolson in the recent Far Rockaway building case. There is strong evidence that some gravels, at any rate, are distinctly inferior for concrete for fire-resistive construction. Cinder concretes are apparently to be viewed with suspicion, especially if the cinders contain much combustible material. Gypsums make good heat-retarding records, but are very soft and weak after tests.

Some New Facts About Brass and Copper

The extensive failures of wrought brasses or bronzes observed in the work of the Board of Water-Supply, New York City, led in many cases to the substitution of steel for the previously used material. Alfred D. Flinn and Ernst Jonson, of the board, called attention to the fact that failures have occurred in cast as well as in wrought metals. They point out that the service strength of brass and bronze is dependent not on the ultimate strength, but on the yield point, and recommend that the testing load should be applied in increments separated by intervals of 5 min. Further, since service strength is not indicated by the yield point, but by the difference between the initial stress and the yield point, initial stresses should be measured by suitable methods and limited by the specifications. The practice of "burning-in" defects in brass castings frequently leaves initial stresses of such magnitude as to cause local failure of the casting. This should be guarded against by annealing. An elongation requirement should be incorporated in every specification to guard against excessive oxidation.

The common belief that hard-drawn copper wire possesses a "skin" of considerable thickness which is of greater hardness and tensile strength than the remainder of the section led E. H. Pierce to make a rather extended investigation on this point. Various samples of hard-drawn copper wire were tested for Brinell hardness, both at the surface and at various points in the cross-section, with the conclusion that the hard-drawn copper wire is equally affected throughout its mass by the cold-drawing process.

Various methods are employed to test sheet brass, such as the determination of the tensile strength, the scleroscope reading and the Brinell indication. In addition to this, there is the more recently introduced ductility, or cupping, test, for which purpose two machines are made—one the Erichsen, which is quite commonly standard in Europe and used in a number of places in this country; and a machine of about the same general characteristics made by Olsen, of Philadelphia. C. H. Davis made tests upon identical or adjacent pieces of sheet brass which were specially gaged and rolled, using each of these methods, and gave complete data for one of the brasses to illustrate the method employed and to show the comparative value and limits of each method of testing. The scleroscope and Brinell were found to be unsatisfactory on thin metal. The Brinell test is satisfactory and comparative on thick metal, and the scleroscope, Brinell and tensile-strength tests do not vary appreciably with the thickness of the metal. As the result of his experiments, Mr. Davis announces that both manufacturer and consumer may safely use the ductility, or cupping, test for thin metal, and the Brinell test for thicker metal.

Many Misconceptions Persist

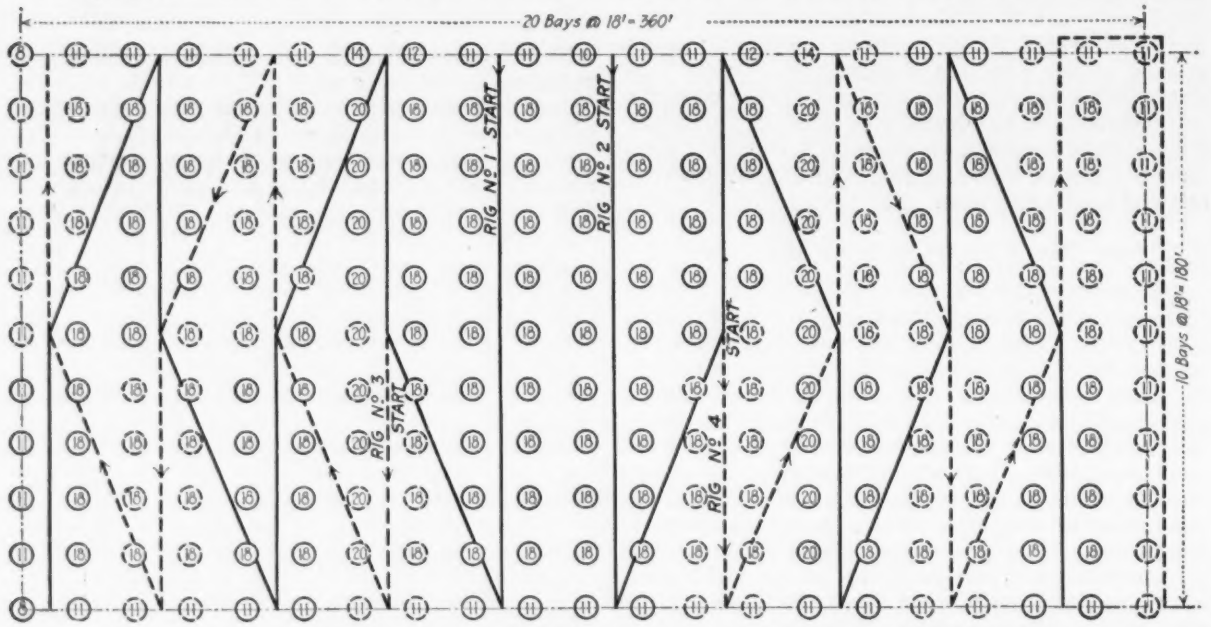
From a manufacturer's point of view it is extremely unfortunate that many misconceptions as to the value of certain processes and indications should persist, especially since it is well known to the manufacturer that these indications are incorrect to a degree that will condemn much excellent metal and result in a higher cost of the product to the consumer. W. Reuben Webster, general superintendent of the Bridgeport Brass Co., presented data to combat the idea that interior surface defects on brass condenser tubes are a cause of corrosion, and that there is no inferiority in material reduced in a single pass as compared to that reduced by several passes. In the first paper, he pointed out that it is a fact that evidences of surface defects can be largely removed by a treatment that will detract from the resistance of the tube to corrosion, while on the other hand the same defects are rendered more highly visible by treatment that tends very materially to increase the resistance of the tubing to destruction. On the second point he found some evidence that led to a belief that material reduced by multiple drafts is more unevenly strained than is the case with the single draft metal, although on this point only partial investigation has been made.

The quantity of tin on tinned copper wire can be readily determined by an electrolytic method, the apparatus used in this test being described by George G. Grower, who shows that the determination occupies only a few minutes and can be directly indicated by the volumetric indications of a gas voltameter, obviating the necessity of any weighing. This test does not, however, reveal imperfections in the tin coating as plainly as some of the sulphide tests. Since it is mainly the bare spots or flaws in the tinning which expose the copper to the attacks of the sulphur in the rubber insulating material, it is not the amount of tin on the wire, but rather its continuity, which is of greatest importance.

Drive 3776 Concrete Piles in 30 Days for Navy

Words "Rush Work for the Government" Prove Open Sesame to Resources of Material Supply Firms, Work Being Organized as if by Magic

THE Navy Department needed greatly increased storage facilities at its Brooklyn yard and needed them immediately. Plans were made for a $1,000,000 reinforced-concrete warehouse 180 x 360 ft. in plan, to rest on 3600 concrete piles. The Turner Construction Co. was asked to undertake the completion of the warehouse within 7½ months of the date of authorization. The rapid-progress schedule laid out to accomplish this feat gave the Raymond Concrete Pile Co., which was requested by the general contractor to drive the piles for a lump sum with $200 a day liquidated damages and no bonus, less than 50 days, or up to June 10 last, to complete its work. At a time when steel, concrete materials, transportation and labor were at a greater premium than in many years, this company bettered its own promise by finishing the piledriving in 30 days' elapsed time, though the number and average penetration of the piles considerably exceeded the figures contemplated.



Circles, drawn about center of each footing, inclose figure indicating the number of piles in footing. Where circles are dotted, piles in the footing indicated were driven by the driver which followed the course indicated by the nearest dotted line. The remaining footings, indicated by full circles, were driven by the other machines.

ZIGZAGGING ACROSS SITE, ALL FOUR DRIVERS WERE ABLE TO KEEP AT WORK, FINISHING ALMOST SIMULTANEOUSLY

Though the work was organized in advance on paper, the contractors were of course unable to place orders for material, ship plant to the work or take any definite steps until the Navy Department, Bureau of Yards and Decks, had authorized proceeding with construction, and the waiting contracts could be signed. This was finally consummated on the morning of Apr. 26 last. From 10:30 on that Thursday morning, when the New York office of the Raymond company received word that the contract was closed, until noon its telephone wires were busy. Within a few hours six cars of bin-tested cement, meeting the navy's specifications, were being loaded at a New Jersey mill; scows of sand and gravel were being loaded for the job at a Long Island plant: two complete driver rigs were en route from the contractor's yard; and out in Youngstown, Ohio, six cars standing ready loaded with pile shells had pulled out of the yard of the firm's Youngstown plant. Meantime, superintendent, office men, foremen and piledriver crews, all waiting in the New York district, had been reached by wire or telephone and ordered to report for work at the job next morning.

The manner of securing the cement is typical of the way in which the supply firms and transportation companies were approached. The Vulcanite Cement Co., on being asked for instant shipment of a large order of tested cement, inquired why, what and wherefore, reminding the contractor of the present state of the market. Its representative was told in a few words that the work was for the navy and that the navy was in a hurry.

"All right," came back over the wire. "Your cement will leave here today."

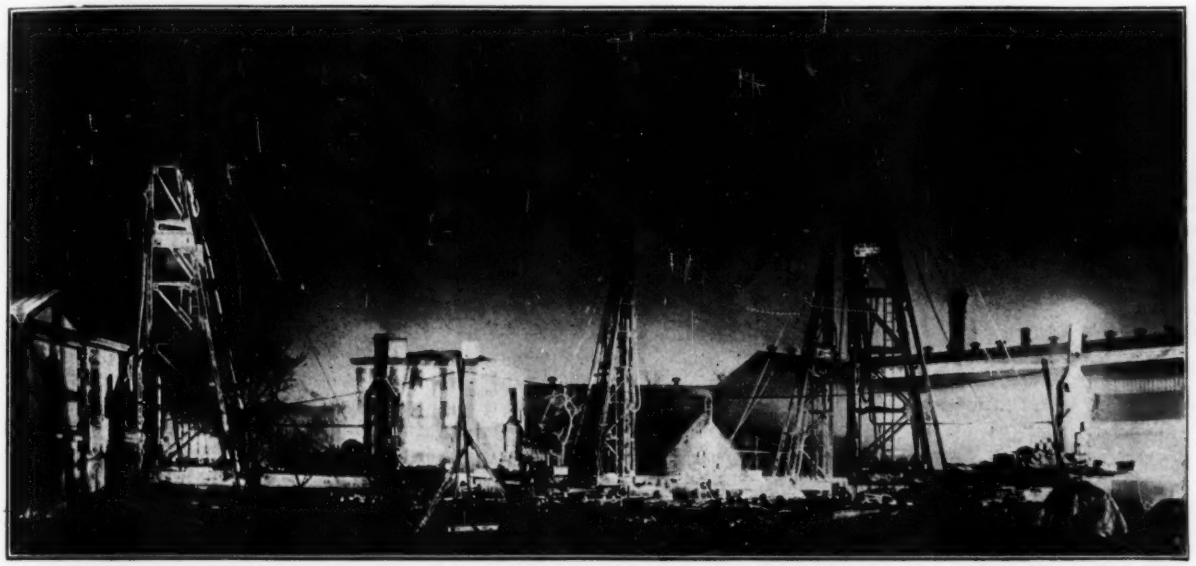
This coöperation was helped along by the publication in the May 3 issue of *Engineering News-Record* of an advertisement announcing at the same time the names of the firms who were doing their part toward carrying out the contract and the unusual progress re-

quired. On the completion of the contract, these firms were thanked in a second advertisement announcing that this schedule had been considerably bettered.

Lose No Time in Starting Work

On Monday morning, Apr. 30, the fourth day after the signing of the contract, the superintendent, from the temporary office already erected at the work, called the firm's main office on the telephone. The instrument had been installed Saturday on a special order from "headquarters" of the New York Telephone Co.

It had been accepted as a foregone conclusion for months that the New York labor market was squeezed dry. No one else would have thought of attempting to get right in the city the 200 men needed to carry on concreting for three shifts a day. The Raymond company, however, called up several labor agencies and inserted an advertisement in six New York papers, offering work at the union wage scale and mentioning that the contract was for the Navy Department. The advertisements appeared on Wednesday night and Thursday morning. Before noon Thursday more than 300



MACHINES WORKED THIRTY DAYS WITHOUT INTERMISSION, EXCEPT FOR SUNDAYS, DRIVING 3776 PILES

He reported that his foremen were driving piles with the two rigs which had reached the work the previous Friday, that barges of sand and gravel were moored to the dock and that six cars of approved cement stood on the siding. He was told that they would have six cars containing additional pile shells within 24 hours.

Small wonder! In addition to the tracer in the New York office, three men were on the road between New York and Youngstown to see that those cars came through. They reached the job Tuesday morning. Meanwhile, the third piledriver had arrived and been unloaded, and on the following Thursday a fourth rig was received and put to work. From then until May 26 the four machines never stopped, except on Sundays. When the final count was taken, it was found that, instead of the 3600 piles contemplated, 3776 had been driven, the penetration of which averaged 22.85 ft. as against 18 ft. expected, and that for each driver crew and each 8-hour shift an average of 21 piles had been driven and concreted.

Labor Troubles Begin Early

Before the last piledriver rig had started to work, trouble developed with the concrete laborers' union. A demand for a wage increase that was not sanctioned by the Building Trades Council resulted in a break between this union and the council and the contractors, which tied up this work as well as much other construction in New York City.

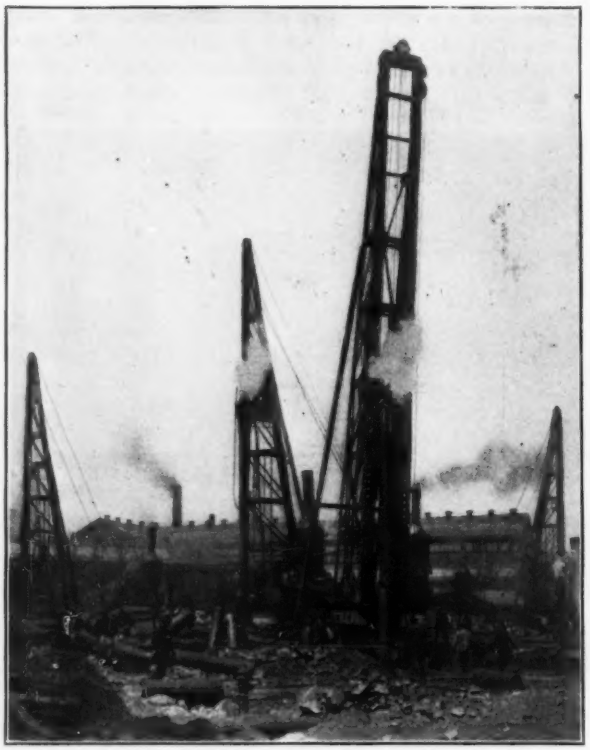
men had applied at the job, and thereafter there was no difficulty with mixing and placing concrete.

Drivers Zigzag Across Lot

The piledrivers used by the contractor are steel-frame turntable machines, equipped with two-drum hoists and No. 1 Raymond steam hammers. They travel on a nest of rollers under the base of the turntable. A timber runway has to be laid for them. This type of rig is considered the most rapid ever developed, and this in spite of the fact that Raymond piles are more difficult to drive, on account of the process involved, than wood piles. The core on which the shells are assembled before driving weighs about 8800 lb. and, furthermore, must be withdrawn after each pile is driven. A record for the number of piles driven in a single shift, which it is thought has never been approached under similar conditions, was established in 1916, when one of these machines drove 119 twenty-foot piles in 10 hours at the plant of the Chevrolet Motor Co. in Flint, Michigan.

As will be seen from the accompanying layout sketch, the first two rigs started at the north side of the building in the center, each one taking two rows of footings as it moved across the site. Each machine then took a diagonal course to the second aisle over between footings, and carried two rows back to the side of the building from which it had started. In the meantime the third and fourth drivers had started in the same

aisles, moving in the opposite direction. The four machines then zigzagged back and forth, crossing each other's paths several times, as shown on the drawing, until the ends of the site had been reached and the last footings driven. This arrangement was considerably better than taking the drivers through the site parallel



FOUR HAMMERS GOING AT ONCE ON RUSH WORK

to the long axis of the building, as it kept all four machines working simultaneously for a greater proportion of the time.

Motor Trucks Again to the Front

Each piledriver was followed around the lot by a portable concrete mixer with its own crew. These mixers, like the piledrivers, were operated three shifts a day. They were supplied with sand and gravel from the dock by one motor truck, which was able to keep them all running. The cement and the shells for the piles were distributed by a horse truck loaded by hand from cars or storage. The sand and gravel, on the other hand, were unloaded by a derrick at the dock. This derrick was operated by the material supply company, using a hoisting engine mounted on a small float, tied up to the dock for the job. The sand and gravel were shoveled into buckets on the barges by laborers. The motor truck, as well as the horse truck, was obliged to work only one 8-hour shift a day.

In spite of the rush nature of the work, the law forbidding Sunday labor was not suspended. This would ordinarily mean on a contract working three 8-hour shifts a day that some of the gangs would be better off than others, either by reason of working in daylight or by reason of getting in more hours every week. To take care of this, the job ran 12 hours on Saturday instead of 16, and each of the three shifts worked for 4 hours, instead of two of them working for 8 hours. Every Monday morning the shifts were moved one 8-hour period ahead, so that the night and day work was evenly divided.

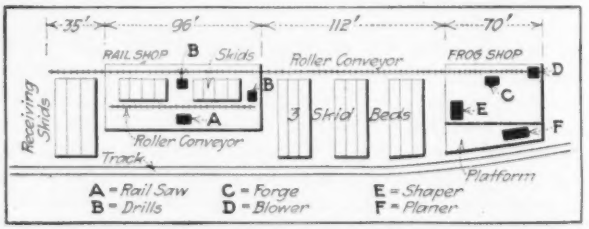
For the Raymond Concrete Pile Co. the work has been in charge of H. A. Christie, superintendent, who is credited with the excellent organization of the work at the site, which resulted in such rapid progress. The entire building is being constructed under the direction of the Bureau of Yards and Docks of the Navy Department, of which Admiral F. R. Harris is chief.

Worn Rails Reclaimed for Branch Lines and Side Tracks

Chicago Great Western Has Plant at Oelwein Where Battered Ends Are Cropped and New Bolt Holes Made

ECONOMY in the use of steel rails in these days of high prices is being effected on the Chicago Great Western R.R. by taking rails removed from main track on account of worn or battered ends, and passing them through a rail-reclaiming plant to make them suitable for use on branch lines and side tracks. This plant was built in 1916 at the railway company's shops at Oelwein, Iowa. Particulars have been furnished by G. M. Crownover, superintendent of motive power.

The arrangement is shown in the accompanying plan. At the left is a large skid rack where the worn rails are delivered. Here they are inspected and marked, all rails for track being cut to a uniform length. The rail passes to a shop 96 x 40 ft., where a roller conveyor



THIS PLANT FITS OLD RAILS FOR RELAYING AND FOR MAKING FROGS

feeds it to a heavy high-speed cold saw. The leading end is cropped, and the rail is then run past the saw to have the rear end cropped. It is afterward shifted to a skid bed serving a pair of three-spindle drills, which form the new bolt holes.

Another roller conveyor carries the finished rails to three skid beds for storage in the yard. This conveyor also delivers rails to the frog shop, where they are sawed to the lengths required for frogs and crossings. This shop, 35 x 70 ft., has a planer, a shaper and a blacksmith forge and blower. Electric power is used, with a motor for each machine.

The buildings are of simple wood-frame construction. The rail shop has roof trusses spanning its entire width (40 ft.) and giving a clear height of 14 ft. Its posts and trusses are spaced 12 ft. c. to c., with intermediate rafters 3 ft. c. to c. The frog shop has side and center posts for its width of 55 ft., with posts spaced 17½ ft. longitudinally, and roof trusses 5 ft. 10 in. on centers.

Standard Bridge Floors of Concrete Slabs on Steel Beams

Weights, Bending Moments and Costs Computed for Usual Specifications—Live-Load a 15-Ton Road Roller

By William Snaith

CONCRETE floors on highway bridges are a sufficiently recent development to make of value any data on the design of the steel floor system to support them. Even the latest works on the subject discuss wooden floors exhaustively, but contain little information as to the stringers and floor-beams for concrete floors. It is the intention of the writer to supply this deficiency by the diagrams here given for standard clear widths of roadway varying from 14 to 20 ft. and for panel lengths from 6 to 35 ft. The economical panel length for concrete floors, when the floor only is considered apart from the trusses, will appear from inspection of a cost chart presented herewith.

Usual Standard Specifications Adopted

All the floor systems investigated have been designed to meet the usual standard specifications as to construction. The dead-load D is taken to include the weight of the concrete slab, the supporting steel and two handrails each weighing 200 lb. per lin.ft. The live-load L is either a 15-ton road roller or a uniform load of 100 lb. per sq.ft., whichever gives the greatest stresses. The roller is assumed to consist of two back wheels with 20-in. face and 5-ft. center to center and of one front wheel with 40-in. face, the axles being 10 ft. center to center and the load on each of the three wheels being 10,000 pounds.

The effect of impact is calculated from the formula:

$$Impact = \frac{L_2}{2(D + L)}$$

This impact formula will give uniformly better results than a straight percentage of the live-load or a formula based only on live-load and panel length.

Calculations Simplified by Assumptions

The calculations have been simplified by several assumptions that err on the side of safety and are only slightly in error.

The maximum bending moment has been assumed to equal the sum of the maximum live-load and dead-load moments. The dead-load per lineal foot per stringer has been taken in round figures at the nearest multiple of 25 above the actual. The live-load from the roller loading on the side stringers is taken in even thousands of pounds.

The weight of each wheel is assumed to act at a point in stringer and floor-beam calculations. In stringer calculations the slab is assumed not to be continuous.

The theoretical length of floor-beam or distance between center lines of trusses is assumed to be 2 ft. greater than the clear width of roadway.

Design of Concrete Slab

The depth of concrete floor slabs is one-twelfth of the maximum span between stringers, with a wearing surface of 3 in. of concrete. An asphalt wearing surface or creosoted wood block on sand will give approximately the same loading. Earth fill to a depth of 4 in. would do so also, but this depth is insufficient. To increase the earth fill to about 9 in. average depth will increase the total stresses in stringers and floor-beams by about 15%.

The total width of slab has been taken to be 1 ft. wider than the clear width of roadway, to allow for a wagon guard on the curb 6 in. high on each side.

Design of Middle Stringers

The dead-load on the middle stringer of course includes the weight of the slab and stringer. For maximum live-load stresses the 15-ton roller only need be considered. For 35-ft. span and 5-ft. spacing this gives greater stresses than a uniform live-load of 165 lb. per square foot.

For a roller of the dimensions and weight assumed, and for spans up to 17.1 ft., the maximum bending moment will occur under one wheel when it is at the center of the span. For spans beyond 17.1 ft. the roller is assumed to be slewed slightly on the bridge, so that one back wheel and the front wheel come directly over the stringer. The maximum bending moment then occurs under the wheel, which has traveled 2 ft. 6 in. beyond the center of the span. The value of the maximum bending moment in foot-pounds when one stringer is assumed to sustain the whole load is given by the formula:

$$M_{max} = W\left(\frac{l}{2} - 5 + \frac{12.5}{l}\right)$$

where W is weight of one wheel and l is the panel length, or span, of the stringer.

The maximum end reaction R is

$$R_{max} = W + W\left(\frac{l - 10}{l}\right)$$

the last term vanishing for spans less than 10 feet.

Design of Side Stringers

The side stringers are designed for a dead-load consisting of one-half the slab between the side and nearest middle stringer, all the slab and curb overhanging, the stringer itself and a handrail assumed to weigh 200 lb. per linear foot.

The roller will produce the maximum live-load stresses in the side stringers when the front wheel and one back wheel are just touching the curb. The portion of each wheel to be supported by the side stringers will be different for different distances of the stringers from the curb. Values for these loadings were carefully calculated for each of the floor systems considered.

Design of Floor-Beams

The dead-load on the floor-beam is conveniently calculated from the stringer reactions, the amount of excess due to increasing the actual figures into round numbers being more than sufficient to account for the weight of the floor-beam itself.

The maximum bending moment due to the live-load occurs with the two back wheels on the floor-beam under the wheel which is 1 ft. 3 in. from the center of the span. The front wheel at the same time is on the center line

of the bridge. For panel lengths less than 10 ft. the front wheel is not considered, and for those over 20 ft. the uniform load of 100 lb. per sq.ft. will give greater values, in general, but in the latter case it is necessary to make the calculations for both conditions.

For the maximum end reaction the roller is placed with the front wheel and one back wheel near the curb and the two back wheels directly over the floor-beam. When the panel length exceeds 20 ft., it is advisable also to calculate the results for uniform loading.

Floor-System Details

The particulars of the floor systems considered are given in the table on page 67. The values given for the dead-load per lineal foot on the stringers are based on actual calculations made for panel lengths of 11, 19, 30 and 35 feet.

The maximum bending moments on the stringers are shown by the curves in Fig. 1. The maximum bending moments for the usual stock sizes of I-beams have also been indicated, and these sizes were adopted in calculating the total weight of the steel in each system. From these curves the stringers used for any span of the standard floor systems can be read directly. Where heavier than standard rolled sections are available, the necessary interpolation is a simple matter.

The maximum bending moments and end reactions of the floor-beams are given by the curves in Figs. 2 and 3. The section moduli required for a unit stress of 16,000 lb. per sq.in. are shown in Fig. 2, and the maximum bending moments on the usual stock I-beams and a selected line of plate girders are also indicated. From the curves in Figs. 2 and 3 the floor-beams for any span up to 35 ft. can be obtained. Fig. 3 can also be used to obtain maximum panel loads for truss bridges.

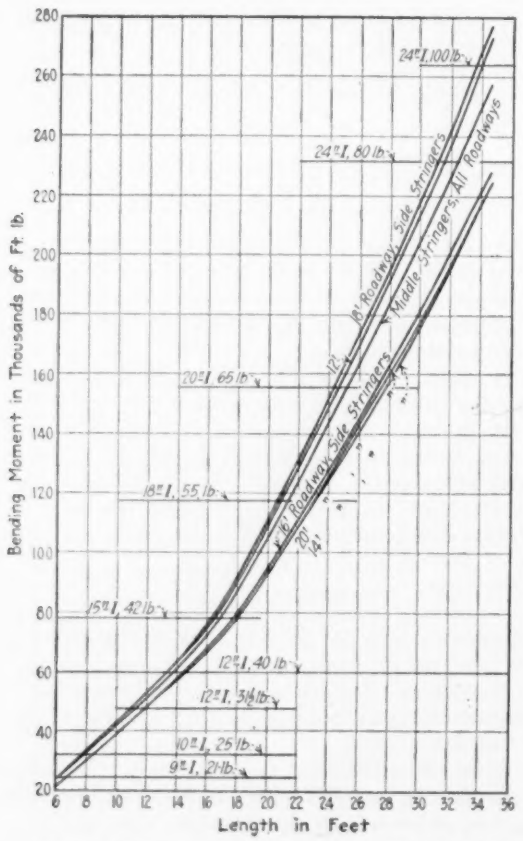


FIG. 1. BENDING MOMENTS FOR STRINGERS

Average Cost Curves

Average prices for steel beams in place in bridge floors and for concrete in place were assumed, and the total cost of one bay (slab, curb, stringers and floor-beam) was calculated. These values were divided by the area of floor supported (nominal width multiplied by panel length), and the results were expressed in curves, Fig. 4.

Owing to the use of commercial sizes and abrupt changes in loading, when, for example, the whole roller is taken into account instead of only two back wheels, or when the uniform live-load replaces the roller load in the calculations, these curves are not smooth and actually cross over one another. It is not to be understood that the figures represent actual probable costs; they

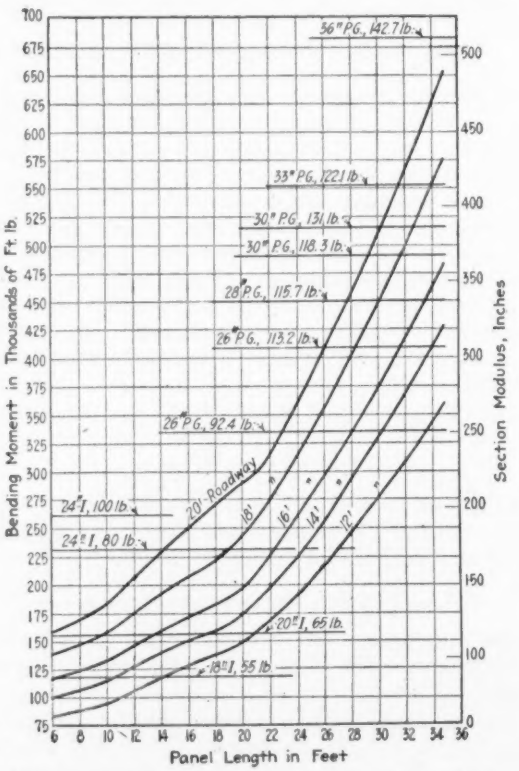


FIG. 2. BENDING MOMENTS FOR FLOOR-BEAMS

are approximate only and will be affected by changes in cost of materials and locality. However, they are of value for purposes of comparison and clearly indicate the economic panel length when the floor systems only are considered.

Alternative floor systems were carefully calculated by the same methods as those adopted and proved to be more expensive in every case. An interesting comparison was made in the case of the 16-ft. roadway system. Five systems were investigated out with various thicknesses of slab and were plotted similarly to Fig. 4. The four-stringer system shows a notable economy at all spans. The seven-stringer system is almost as economi-

cal at 10-ft. panel length as the four-stringer system and least so at 35-ft. panel length. Exactly the reverse is true of the six-stringer system. The way in which the curves crossed one another would show that no general statement would be warranted that the fewer the stringers the greater the economy. Each case must be settled on its merits.

The amounts of the errors due to the various assumptions were carefully investigated. They are inconsiderable and invariably on the side of safety. The expression of the dead-load figures in multiples of 25 lb. will not in any case involve an error of more than 1% in the total, and the effect of the round figures adopted for the roller loadings on the side stringers does not exceed the actual loadings by more than 4% of the total results at 35-ft. panel lengths. The sum of the three errors above will hardly amount to 4% for panel lengths less than 20 ft. and not more than 6% at 35 ft. in any instance.

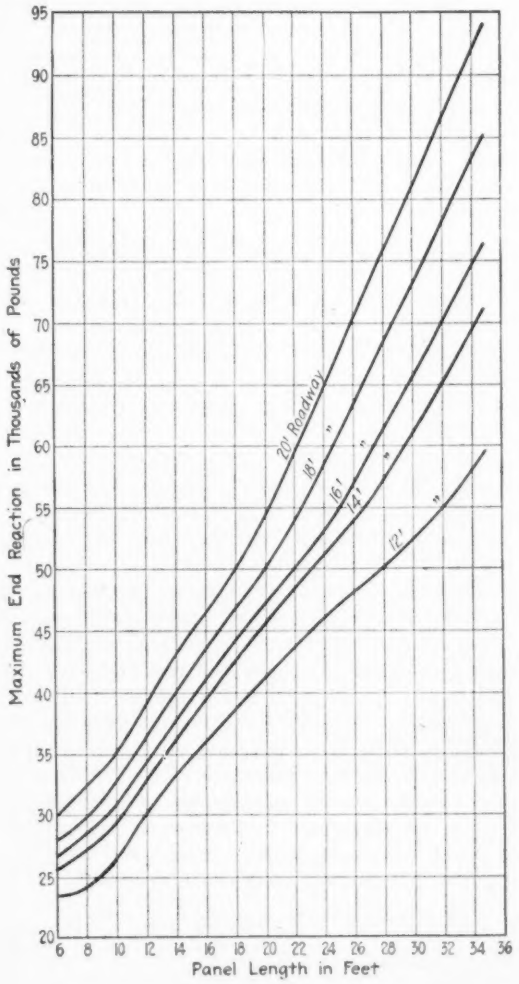


FIG. 3. END REACTIONS FOR FLOOR-BEAMS

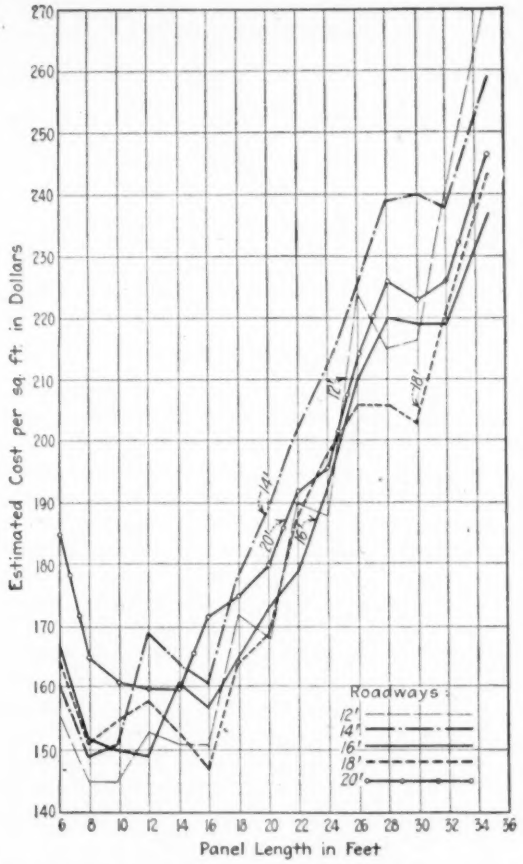


FIG. 4 ESTIMATED COSTS OF FLOORS PER SQUARE FOOT
Includes floor-beams, stringers, slab and curb

Hudson Bay Railway Nearing Completion

Rails have been laid on all but 92 miles of the 424-mile Hudson Bay Ry. in Canada, states Frank Cochrane, Minister of Railways and Canals, in his annual report for the year ended Mar. 31. The part remaining is that between the second Nelson River crossing and Port Nelson. All but 11 miles of this section has been graded, and it is stated rails will be laid to Port Nelson this year. Of the estimated cost of $26,000,000 for the railway and the harbor, $18,175,000 has been spent. Work on the harbor has been slowed down because of the war conditions.

PARTICULARS OF FLOOR SYSTEMS CONSIDERED IN ANALYSIS OF STRESSES

	Dimensions of Standard Floor Systems					Dimensions of Alternative Floor Systems					
Clear width of roadway, in ft	12	14	16	18	20	12	16	16	16	16	18
Number of stringers	3	4	4	4	5	4	5	6	7	9	5
Thickness of slab, in in	8	8	8	8	8	8	8	7	6	5	8
Spacing of middle stringers, in ft	-	5	5	5	5	5	5	4	3	2	5
Distance middle to side stringers, in ft. and in	5-0	3-9	5-0	5-0	4-6	3-9	3-3	2-3	2-3	2-3	3-9
Distance side stringers to end of floor-beam, in ft. and in	2-0	1-9	1-6	2-6	1-6	0-9	0-9	0-9	0-9	0-9	1-3
Dead-load in lb. per lin.ft. on middle stringers:											
Panels 6 ft. to 19 ft	550	550	550	550	550	550	550	400	270	160	550
Panels 20 ft. to 35 ft	575	575	575	575	575	575	575	400	270	160	575
Dead-load in lb. per lin.ft. on side stringers:											
Panels 6 ft. to 19 ft	675	600	625	725	600	500	475	400	350	375	550
Panels 20 ft. to 35 ft	700	625	650	750	625	525	500	400	350	375	575

Army Training Camps Have Definite Curriculum for Engineer Officers

Courses Aim To Train Candidates in Their Duties as Instructors, Managers and Leaders

THE instruction now being given in the various army officers' training camps follows as definitely planned courses as are to be found in any college. The prescribed studies for engineer officers are summarized below:

Organized Like Regulars

At first, each camp was organized as one provisional training regiment, subdivided into 15 companies. At the close of the first period of instruction the engineer companies were removed to special engineer training camps, and the remaining companies were reorganized as infantry, cavalry and artillery units.

The ordinary regimental, company, troop and battery records, reports, rations, etc., are used so far as possible. Regular-army officers assigned to each company as instructors are in full charge, regardless of rank with respect to reserve officers. However, they are relieved from administrative work as far as possible except as to its supervision. All records, rosters, etc., are prepared by designated reserve officers and candidates as a part of their instruction. All in attendance are cautioned that, except for the purpose of maintaining discipline and order, all must forget rank, and live and work on equal terms.

Living the Common Soldier's Life

The courses of instruction are based on the work done in the United States Service Schools at Fort Leavenworth, Kan., and on the experience of foreign armies during the past three years. The first requisite is thoroughness and precision in fundamentals and details of military movements. The prescribed courses are designed to teach as thoroughly as possible in the short time available the duties of an officer as (1) an instructor, (2) a manager and (3) a leader.

The duties as *instructor* are taught by subjecting the future officers to the same drills and individual training that they in turn must give to their future commands, with the same rigid discipline and attention to details that they must exact. The training as *manager* is secured by subjecting the men to the same mode of life that will obtain with respect to their future commands, supplementing this with instruction in the proper method of supplying, messing, administering and disciplining organizations, and providing for health, sanitation, comfort and welfare. The instruction as *leader* is given by illustrating the tactical employment of troops and by giving each man an opportunity for practice in tactical leadership as corporal, sergeant, lieutenant, captain and major.

All Men Must Take Courses

Regardless of age or grade, all men in attendance at the camps are required to take the prescribed courses, except those men designated as assistant instructors in particular subjects and except that engineer officers who have not volunteered to serve with combat elements (the Class B group) are not required to complete the courses laid down for pioneer troops.

The schedules are based on a minimum day of ten hours, five in the morning, three in the afternoon and two in the evening on all days except Saturday and Sunday. Saturday is used for bringing up to requirement work that has been interrupted by weather and unforeseen conditions, for vaccinations, examinations, tests, etc.

The work of the day begins with roll-call formation (reveille) at 5:30, breakfast at 6 and first instruction at 7. Dinner comes at 12:15 usually. Afternoon instruction begins at 1:30 or 1 and lasts to 4:30 or 5. Retreat formation, at about 6, is followed by supper. Evening study lasts from 7 to 9; lights are out at 9:30 or 9:45. The hours are varied more or less from week to week as the demands for the time of the men may require.

Special Attention to Military Engineering

In regard to the course for engineer officers, it should be noted that it is expected that the men being trained are qualified as civilian engineers, but practically untrained as soldiers, so that purely military subjects must not be curtailed to give them instruction in fields in which they are proficient or can grasp readily without interference with duties of command. For this reason the engineer training in camp has been confined to the theory and practice of military engineering to the extent that it is a specialty and not merely the application of civil-engineering practice. Advantage has been seized of the opportunity to enable these engineer officers to gain familiarity with field firing and other infantry work that has an important bearing on the tactical application of military engineering.

The subject given in the schedule as "Engineers in War; Military Engineering" is the general subject covered in lectures, and includes the duties of engineer troops in the theater of operations, the direction of engineer operations, the application of reconnaissance, bridging, roadbuilding, fortifications, castrametation, demolitions, care of animals, railroad and other special work, and the training of engineer troops.

FIRST PERIOD—FOR ALL ARMS (5 WEEKS)

	Approximate Hours
Company organization and equipment	8
Practice marches	10
Physical drill ("setting-up exercises")	12
Infantry drill	50
Use of rifle and bayonet	20
Signaling (visual)	22
Military theory	64
Study hours	50
	186

SECOND PERIOD—PIONEER ENGINEERS (8 WEEKS)

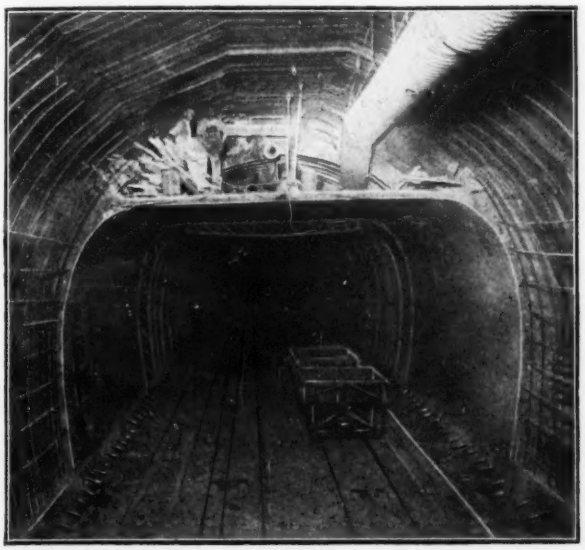
	Approximate Hours
Organization and equipment of engineer troops	6
Engineers in war; military engineering	25
Tactical employment of military engineering	25
Reconnaissance	8
Bridging and road repair	16
Field fortifications	32
Obstacles and trench accessories	5
Trench warfare	15
Cordage	3
Demolitions	4
First aid, hygiene and sanitation	13
Physical drill or riding	10
Company and battalion drill	10
Use of rifle, bayonet, pistol and machine gun	55
Tent pitching and camp making	10
General military theory	65
Study hours	40
	342

Maneuvers—4 days.

From Mixer to Forms at a Mile a Minute

Pneumatic Method Used for Delivering Concrete 4000 Feet in Twin Peaks Tunnel at San Francisco

THE work of lining the Twin Peaks tunnel with concrete has been expedited by using the pneumatic method for delivering the mix, as well as collapsible steel forms designed especially for this work. The forms, which were described on p. 273 of the *Engineering Record* for Feb. 26, 1916, have made it possible to carry out the work so that both walls and the ceiling slab could be poured simultaneously. The wall footings were poured first; and after the walls and ceiling slab were poured, the arch was put in in a third operation. Where an invert was required, it was poured in a fourth operation.



SPACE ABOVE CEILING SLAB IN THE TWIN PEAKS TUNNEL IS FOR VENTILATION

Concreting was carried on from both ends of the tunnel, the air for all operations being compressed at the central power plant at Laguna Honda station. This compressor plant consisted of two 750-cu.ft. and one 1100-cu.ft. two-stage compressors run by two 100-hp. and one 150-hp. motors respectively. From this plant air was conveyed to the east portal through a 6-in. pipe, 7000 ft. long, and delivered into a cylindrical receiver or balancing reservoir, 6 x 10 ft. in size.

Mixing Without a Mixer

From this receiver the air passed through a 4-in. pipe to the mixing chamber, located underground and just above the ceiling slab of the tunnel. This chamber was a steel cylinder 3 ft. in diameter and 5 ft. high, with a conical bottom terminating in an 8-in. elbow leading to the delivery pipe. The materials were admitted to this mixing chamber from a charging hopper immediately above the mixer, where the aggregate was measured, all the materials coming into the hopper by gravity flow from bunkers above.

A crew of three men was stationed at the mixing chamber, two operating the chutes leading into the measuring hopper and one man operating the levers admitting charges to the mixing chamber and controlling the compressed air.

When the dry batch was ready in the hopper, a door in the top of the mixing chamber was opened and the charge dropped in together with a measured quantity of water. The charging door was then closed by the air-operated piston, and a valve admitted compressed air through two 2-in. pipes at the back of the elbow below the mixing chamber. These pipes directed their jets horizontally into the elbow and on into the delivery pipe, their function being to mix the batch and start it along the delivery line. Immediately after admitting air at the back of the elbow the main valve was opened, letting air in through four 2-in. pipes at the top of the mixing chamber. This put a pressure directly behind the batch and kept it moving through the line.

Experience in Pneumatic Delivery

After some experience with the long delivery line, it was found that the air supply could be conserved by getting about three batches into the line before keeping the pressure on long enough to send the concrete clear through to the point of delivery. Under this method a batch was put into the mixing chamber and then advanced a distance of several hundred feet in the delivery pipe by the pressure from the main air line. The pressure was then cut off and another batch admitted in the same way. After the third batch had been put in the line, the air pressure was kept on until the pressure gage on the delivery line approached zero, indicating that the charge had been delivered at the far end.

The average speed of a single charge going through the line was reported as about a mile a minute. The speed of operation of the system was found to depend upon the length of the pipe line and the skill of the operator. The usual rate, using 16-cu.ft. batches, varied from 70 batches per hour at 300 ft. to 30 batches at 4000 ft. Efficiency of the system was found to be largely dependent upon the operator. A careless operator might easily cause a plug in the line that would take some time to clear.

If the charge is delivered at the high rate of speed at which it is transmitted, it strikes a very considerable blow at the point of delivery. To take up this shock and wear, a hopper with renewable steel plates was secured to the tunnel timbers opposite the end of the delivery pipe. After expending its force on these baffle-plates the concrete flowed in gravity chutes into the forms. By cutting off the air pressure at the proper moment the operator could deliver the batch without the shock that accompanies delivery under full pressure. In the case of the arch, where gravity flow was not possible, concrete was shot directly into place, lengths of pipe being removed from the end of the line as the space was filled.

From one end the delivery pipe was laid on a 3% downgrade, and from the other end the line ran up a 3% grade until the elevation above the mixing chamber was 111 ft. The delivery of concrete on the upgrade required more air, but involved only a small part of the trouble with clogging that occurred on the downgrade. The operators expressed an opinion that this difference was due to the tendency of wet concrete to flow downgrade. On the downgrade delivery the action of gravity would tend to spread the batch and let the air pass over it, while in the upgrade delivery gravity acted on the batch in one direction and air pressure in the other, thus tending to hold the charge together.

Except for the elbow immediately under the mixing chamber, there were practically no bends or angles in the pipe. The pipe used was 8-in. steel casing in 12- and 20-ft. lengths with flanged joints. It is notable that a large percentage of the wear occurred at joints. As leaks appeared, indicating worn spots in the pipe, patches were clamped on until such time as the leakage became excessive. If the hole occurred at the joint, a short section would be cut off and the end of the pipe heated and again flanged so that it could be put back in service.

The total concrete required per linear foot of tunnel varied with the design of the cross-section from 5.6 to 8 cu.yd. The total quantity handled by the pneumatic process was about 65,000 cu.yd. The concrete mix used was 1 : 2¼ : 5½, the sand being well graded and the gravel being ¼ to 1½ in. in size. The batch consisted of two sacks of cement, 4.5 cu.ft. of sand and 11 cu.ft. of gravel, the water used being sufficient to make a fairly wet mix. With the cement, 8 lb. of hydrated lime per 100 lb. of cement was added. It was found to constitute an excellent lubricant and is believed to have been a factor in attaining the record distance of 4000 ft. for "shooting" concrete by means of compressed air.

The Twin Peaks tunnel was constructed under the supervision of M. M. O'Shaughnessy, city engineer of San Francisco, the contract being held by the firm of R. C. Storrie & Co.

Unusual Location of Tanks Obviates Pumping at Sewage Filters

Clarification at Head of Outfall Gives Low Self-Cleansing Velocity and Saves Grade—Horizontal-Flow Primary Filters of Coke Make High Rate of Sand Filtration Possible

By G. EVERETT HILL
Vice President and Chief Engineer City-Wastes Disposal Co., and Consulting Engineer, New York City

THE CLARIFIED SEWAGE PASSES THROUGH HORIZONTAL COKE FILTERS, A DOSING CHAMBER AND INTERMITTENT SAND FILTERS

WITHHOLDING sewage solids in one-story digestion tanks at centers of population made possible, in a long gravity outfall sewer through a flat valley, a grade, self-cleansing and yet so low that head was gained sufficient to force the sewage through two sets of filters, though pumping at first seemed inevitable.

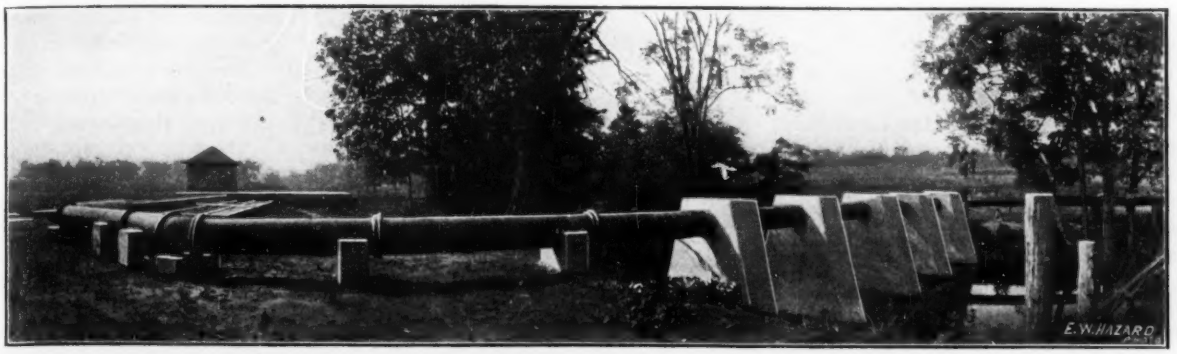
Topography Creates a Problem

Southington, Conn., an iron- and steel-working community with a population of 4500, lies on both banks of the Quinnipiac River, a tributary of Long Island Sound, about 22 miles north of New Haven. The borough is scarcely half a mile wide, but nearly three miles long. The side hills, flanking the river, give ample grade for most of the lateral sewers. But the valley itself, the zone of densest population, is very flat. The river (normal flow at Southington about 27 cu.ft. per sec.) has a fall, within the borough, of only 0.143%. A 15-in. sewer laid with such a grade would barely develop a self-cleansing velocity, with nothing to spare for earth cover at the upper end of the valley or for use in disposal works at the lower end. But even the comfort that a flat-grade 15-in. sewer could give was denied, so far as the northernmost third of the town was concerned; for the flow of sewage from that section will, for many years, be barely sufficient to produce a depth that will buoy normal sewage solids in a 12-in. pipe. The difficulty was increased by the presence of two dams within the borough, causing slack water and consequent high-level ground saturation for 4900 ft., or 37% of the entire distance.

The surveys showed conclusively that a main sewer, of size properly proportioned to the volume of sewage produced, laid on a grade that would make it self-cleansing and starting at the northern end of the town far enough below ground to make house connections possible, could not be brought to any available point of disposal at an elevation far enough above the surface of the river to permit gravity flow through a disposal plant and gravity discharge of the effluent into the river. It was possible of course to maintain depth of flow in a large-sized flat-grade main sewer by admitting river water at its upper end, but this would have added line is flushed copiously and strongly by a high-level flush tank (fitted with an 8-in. siphon), which collects and discharges periodically 2000 gal. of sewage from a large school. All other sewers, carrying solids as well as liquids, are laid with grades that will develop a velocity of at least 1.6 ft. per sec.

Light-Grade Effluent Conduit Keeps Clean

Some doubt was felt about the ability of the light-grade effluent line to keep itself free from filamentous secondary growths; but 16 months of operation have proved that this fear was groundless. The pipe has never been cleaned artificially. Some growth can be found in it, but this is always dislodged and carried out before it attains any considerable thickness—¼ in. seems to be the maximum.



THE TANK EFFLUENT OUTFALL SEWER ARRIVES AT THE FILTERS NEARLY 8 FEET ABOVE THE RIVER LEVEL

very seriously to the size of the disposal plant and to the costs of construction and maintenance.

Fortunately, the term that seemed the stumbling-block in this case, "self-cleansing velocity," is relative. It means simply a velocity that will sweep on continuously any solids that, without it, might become stranded and obstruct the flow. If there be no solids, *any* velocity, no matter how low, is a self-cleansing velocity. And so the solution lay in the elimination of the solids that compelled the velocity that demanded the grade that threatened to eat up the available fall.

The borough, therefore, was divided into two districts. At a central point in each an underground digestion tank was built, with comparatively short, and consequently shallow, sewers coming to it from *all* directions. The northern tank is near the main railroad station and just across the track from a large tool factory. The southern tank is in the yard of another factory and close to the main street and to the Plantsville railroad station of Southington. The effluent outlet from the northern tank is an 18-in. pipe, laid with a grade of but 0.05% close to the edge of the river and below the level of the upper mill-pond. It receives no accessions until it reaches Plantsville, 2600 ft. farther down the valley, where the effluent from the southern tank enters. From this point it continues for 5300 ft. as a 20-in. pipe, laid with the same 0.05% fall, to the disposal field, where it arrives nearly 8 ft. above the normal level of the river, sufficiently high to provide for gravity flow through and from the purification plant. In other words, by withholding the solids locally and making the main sewer an effluent outfall, 7900 ft. of the total distance was traversed with a loss in elevation of only 1 ft. in 2000.

At the northern end of the borough, 675 ft. of 12-in. main sewer was laid with a grade of 0.13⅓%, but this

The total length of sewers constructed as a first unit is 13.2 miles. All lateral sewers, save a few which are to be extended, are fitted with 350-gal. flush tanks (Miller siphons), set to discharge daily. Vitrified clay sewers in wet ground were jointed with "Filtite." The 18-in. effluent outlet, on the bank of the upper mill-pond and below its water level, was built of cast-iron pipe with leaded joints. The river is crossed at seven points: Four times by inverted siphons, on raw-sewage lines; and three times, as the effluent main approaches the disposal beds, by cast-iron pipe, on reinforced and ice-armored concrete piers, laid on uninterrupted grade and safely above flood-level.

One-Story Digestion Tanks of Special Design

The ultimate daily flow of sewage (from 21.4 miles of sewers) was estimated as 2,400,000 gal. This included an allowance of 64,000 gal. for groundwater infiltration. The actual leakage is less than 40% of this. Of the total flow, 70% will come from area tributary to the northern digestion tanks and 30% from area draining to the southern tanks. The first unit of disposal, estimated as sufficient for five years, provides for a daily flow of 500,000 gal. The disposal plant, as planned, includes:

	Already Built	Additional Future Units
Digestion tanks, northern district (two chambers each)	1	4
Digestion tanks, southern district (two chambers each)	1	4
Primary filters, at disposal field	8	24
Dosing tanks, at disposal field	1	3
Sand beds	6	14
Sludge beds, for drainings from primary filters	2	2 (larger)
Flood lock	1	....

The digestion tanks are single-story underground concrete structures, roofed with steel and concrete, with a working depth of 9 ft. The inlets which can be individually closed by plug valves or controlled by concentric choke-rings, are placed and spaced so that the incoming sewage is discharged horizontally, below water surface and scum, against the rear-end wall of the tank, which checks the velocity and diffuses the liquid over the entire vertical cross-section of the tank's contents. The average period of detention within the tank is 6 hours, and the average rate of horizontal flow to the outlet end is 1.3 in. per min. As the tanks are built with diverging side walls, the rate of travel becomes slower and slower, so that, at the outlet end, minute flocculent particles that would be carried out by the average velocity have opportunity to settle. Near the outlet end, the liquid passes under a single baffle wall, dipping to the plane of greatest clarity between the sludge and scum, and then escapes into an outlet channel by creeping over a weir wall, as long as the tank is wide, in a sheet so thin that it will not float such occasional masses of sludge as are buoyed to the surface beyond the baffle.

Horizontal-Flow Coke Primary Filters

Before application to the sand beds, the tank effluent passes transversely through horizontal-flow streaming filters of foundry coke. Each bed is 28 ft. long, 4 ft. thick and 5 ft. deep (20.7 cu.yd.), held between two sieve-like walls of hollow brick laid as headers, with a feed channel at one side of the bed, an effluent channel at the other and proper gates for controlling or reversing the flow, or for draining each filter to the special sand filters used as sludge beds. These primary filters are designed merely as strainers. They effect very little improvement in the liquid as measured either by chemical or bacteriological tests, for the passage is too rapid for any save mechanical action; but the rough coke will withhold certain semiliquid, gelatinous, albuminous materials that escape freely from the digestion tanks because they have practically the same specific gravity as water, but which diminish seriously the capacity and efficiency of sand beds by coating the surface with deposits more or less impervious to both water and air. Eight of these streaming filters are included in the first unit of construction. They are used in alternation, two or three at a time, while the others are draining, aërating and consuming, in part, the impurities retained in a previous period of service.

Automatically Controlled Dosing Chambers

The effluent from the primary filters passes into a flush tank with two chambers, one holding 12,800 gal., for use alone while house connections were few, and the other with an additional capacity of 9275 gal. As the head needed for the operation of siphons was not available, automatic alternate discharge through two outlet pipes was secured by a mechanical valve system, controlled by floats, designed and built by the Pacific Flush Tank Co. A system of distributing chambers allows for the delivery, by either pipe, to any one or any group of the sand filters.

Six sand beds, each 27 in. deep, with a combined effective area of 1.54 acres, were included in the first unit of construction, having a nominal daily capacity of 500,000 gal. Land, 9.2 acres in all, was secured for future extensions. Local sand was used, under inspection and test that required an effective size of at least 0.28 mm. and a uniformity coefficient not greater than 3.5. The entire area of sand beds was underdrained with agricultural tile, ventilated at heads and junctions by vertical standpipes. The main underdrains, on their way to the river, pass through a masonry flood-lock so constructed that unusual rise of water in the river will form an air-bind in a trapped pipe and prevent any setting back of muddy river water into the underdrains of the disposal plant.

The disposal site, with a frontage of 692 ft., abuts upon the main highway, which carries the trolley traffic from New Haven, Waterbury, Meriden and New Britain. It has been neatly fenced, graded, terraced, grassed, planted and tended. Passing strangers not infrequently call each other's attention to "the park."

The system was built by the Berardino & Tomassetti Construction Co., of Meriden, under the supervision of the City-Wastes Disposal Co., of New York, the designing engineer. The cost of construction was $129,503. The total cost, including land purchases, engineering and legal and office expenses, was $149,944.

Fifteen Months' Performance

The conditions, after 15 months of operation, are as follows: Connections include 228 houses, 4 schools and 1 large factory. Total flow in 24 hours ranges from 200,000 to 250,000 gallons.

The digestion tanks have never been cleaned. The chamber of the northern tank first used contains at its inlet end 6 in. of sludge and 11 in. of scum. The second chamber (in use three months) has accumulated at its inlet end 2½ in. of sludge and 7 in. of scum. Neither chamber has any measurable depth of sludge or scum at the outlet end.

The digestion tank of the southern district (only one chamber in use) contains at its inlet end very little sludge (perhaps an inch) and 3½ in. of scum. The outlet end shows neither sludge nor scum. The effluent from both is satisfactory.

Three primary filters are in use daily, while five are drained and aërating. None of these filters has been cleaned, but a gradual increase of head needed to drive the sewage through indicates that the coke must soon be forked over and washed. The excellence of the work these filters are doing is evidenced by the performance of the sand beds

One Bed at a Time Takes Care of Flow

One sand bed at a time has always proved able to care for the entire daily flow, though the rate of application occasionally has exceeded 900,000 gal. per acre per day. Save when the outlet is closed by river flood, all standing water disappears from the beds in from 5 to 15 min. after the termination of the flush-tank discharge. The only raking given the sand beds consists in the occasional replacing and releveling of sand moved by the force of the flush. In warm weather, each bed is used but one day in the cycle of rotation. In winter, each bed is used for three consecutive days. The sludge beds are cleaned after each application by raking off the

deposits, which have first been allowed to drain and dry. No sand has been removed by scraping.

Southington possesses no facilities for chemical and bacteriological tests. The last report on the Southington plant from the state laboratory at Middletown showed the following, all data being expressed in parts per million:

	Sewage	Effluent	Percentage of Removal
Turbidity	20 0	0 0	100
Organic nitrogen	28 70	4 92	82
Nitrates	0 0	12 0	
Oxygen consumed	144 0	2 2	98
Chlorine	12.0	12 0	

No renewals or repairs were necessary in 1916. Operating expenses for the year were $1465, or 33c. per head of population.

Texas Constitutional Amendment Would Promote Land and Hydraulic Interests

The encouragement of drainage, irrigation, flood control and water-power development in Texas is the purpose of a constitutional amendment which the state legislature has ordered to be submitted for public vote in August, 1917. At present, the issue of bonds for drainage, levee or irrigation districts is limited to 25% of the assessed value of the lands to be benefited. Such lands (wet, arid or liable to overflow by floods) are necessarily assessed at very low rates, so that the bond issue is usually quite inadequate for carrying out the necessary work for reclamation or protection. In some cases this limitation has been avoided by the landowners of a district agreeing to the assessment of the lands at their estimated value after the construction of the improvement works. This is unsatisfactory, however, and it is thought that investors might question its validity. The proposed amendment provides for the organization of reclamation and conservation districts (according to physical and not political boundaries). If the property owners of the district adopt the project for the necessary works (reservoirs, levees, dams, drainage ditches, hydro-electric plants, etc.), the legislature will authorize the issue of bonds sufficient for construction and maintenance of these works. It will also authorize the collection of taxes sufficient for interest and to create a sinking fund for paying off the bonds. The indebtedness, if the amendment goes through, will be a lien upon the property assessed.

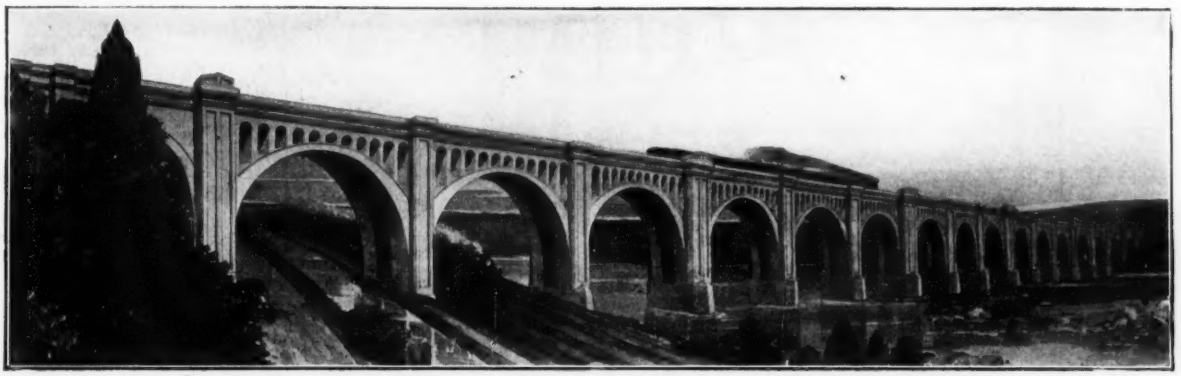
Bids for Concrete Arch Viaduct Less Than for Steel Design

James River Bridge at Richmond, Va., Illustrates Advantages of Concrete Over Steel Railroad Bridges

By H. G. Perring
Member of Firm, J. E. Greiner & Company, Baltimore, Md.

Of particular interest in illustrating the comparative costs, at present-day prices, of concrete and of steel bridges of the viaduct type is the bridge now being constructed over the James River at Richmond, Va. Owing to the low cost of the concrete aggregates, furnished by the railroad, the bid for a concrete arch viaduct 2278 ft. long was nearly $15,000 less than for an alternate steel design of plate girders and steel towers on concrete pedestals.

Late in 1916, plans were prepared for a bridge to replace the present single-track steel structure at the Belt Line crossing of the James River in Richmond by the Richmond, Fredericksburg & Potomac R.R. and the Atlantic Coast Line R.R., joint owners. The present structure, built in 1889, proving inadequate for the increasing traffic demands, a new double-track structure is being built parallel to and 30 ft. upstream from the old bridge. The new structure is designed for the equivalent of Cooper's E-60 loading.



ADOPTED DESIGN FOR JAMES RIVER BRIDGE, RICHMOND, COMPARED FAVORABLY IN COST WITH STEEL VIADUCT

Alternate Designs Furnished

The river bed is of granite, and a solid foundation is secured with comparatively little excavation. The maximum river stage is 11 ft. above mean water, while at times a large part of the river bed is exposed. This location seemed well suited to concrete arch construction, but alternate designs were made by the consulting engineers for a concrete arch bridge and also for a steel viaduct with plate-girder spans, supported on steel towers resting on concrete piers.

Bids were invited and received for both designs on Jan. 25, 1917. A comparison of the lowest bids is as follows:

Concrete Arch		Steel Viaduct	
Bid to subgrade	$416,122	Bid to subgrade	$444,885
Ballast and ties	5,520	Track	7,950
Rails	6,532	Approaches	49,600
Approaches	49,600		
	$477,774		$492,435

These prices are based upon a very low cost for aggregates, as the railroad company agreed to furnish sand and gravel for concrete at 60c. per cubic yard.

Comparison of Costs

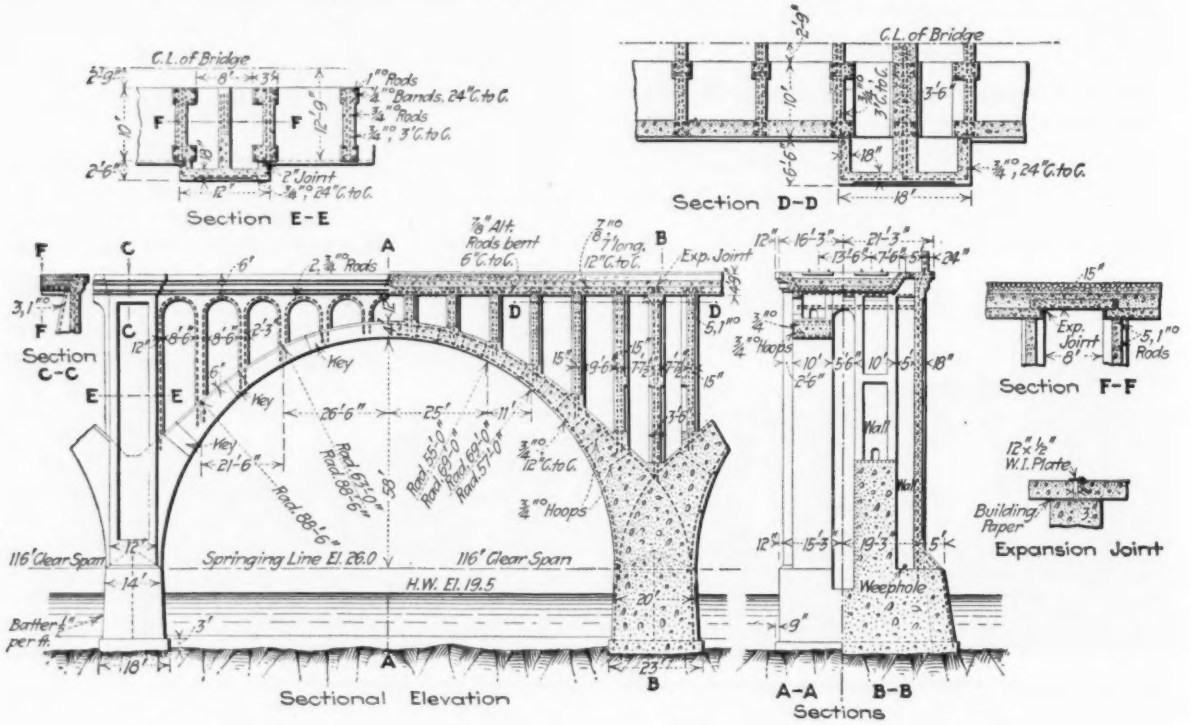
The prevailing commercial prices per cubic yard of these aggregates at Richmond were $1.05 for sand and $1.20 for gravel. The concrete arch bridge contains 41,400 cu.yd. of concrete and the steel structure 3350 cu.yd. In order to make a comparison of figures that could have been expected had the contractors furnished sand and gravel at market prices, there should be added to the above totals $30,900 for the concrete arch design and $2530 for the steel design, thus making the comparison as follows: Concrete arch, $508,674; steel viaduct, $494,965.

This in general may be taken as a fair comparison of the relative costs of the highest types of design, as exemplified in a concrete bridge with its beautiful lines and the advantages of ballasted track, low maintenance and long life, as against a plain and less satisfactory design in steel with open floor, higher maintenance and shorter life. The contract was awarded for the concrete arch bridge, which is now under construction.

General Dimensions of Arch Design

The concrete design provides for a bridge 32 ft. 6 in. wide and 2278 ft. long, including abutments. The base of rail is at elevation 100 above the river level, which is taken as datum. There are twelve arches of 116 ft. clear span and 58 ft. rise, three arches of 122 ft. clear span and 58 ft. rise, three arches of 60 ft. clear span and 30 ft. rise, and 70 ft. of abutment approaches. The main-span piers are 14 ft. thick at springings, with an abutment pier 20 ft. thick for each group of three arches. The abutment and the 60-ft. arches have solid earth-filled spandrels, while the main arches are of open spandrel design with slab floor system. The main arches spring from elevation 21 and are full centered.

Concealed expansion joints are provided for the structure above the arches at each pier throughout the bridge. No hand rail is used, but refuge bays 5 ft. wide are provided over each abutment pier on both sides of the bridge. The upper part of each pier has a pediment which, together with the refuge bay treatment, breaks the straight line of the coping, giving a pleasing artistic effect.



DETAILS OF TYPICAL 116-FOOT ARCH DESIGNED FOR COOPER'S E-60 LIVE-LOADING

All surfaces of the concrete are reinforced to prevent face cracking, and the reinforcement of the whole structure is in accordance with the standard specifications of the engineers, allowing 16,000 lb. per sq.in. tension in steel and 650 lb. per sq.in. maximum compression in the concrete. Exposed surfaces are given a spade finish, secured by using dressed-lumber forms and spading the concrete during placing to secure a dense mixture of mortar near the form surface. All arches and walls are provided with drainage and are waterproofed on the inside with a bituminous membrane.

The contract is being executed by W. W. Boxley & Co., of Roanoke, Va. J. E. Greiner & Co. are the consulting engineers in charge of the design and construction and are represented on the work by E. W. Stearns, resident engineer. S. B. Rice is engineer, maintenance-of-way, and E. M. Hastings, resident engineer of the Richmond, Fredericksburg & Potomac R.R. J. E. Willoughby is chief engineer of the Atlantic Coast Line Railroad.

Interlocking Blocks Tied Together Make Concrete Chimney

System Common in Europe Is Used for First Time on This Continent in Canadian Pacific Yards at Toronto

By W. S. Winters
Toronto, Canada

A SPECIAL type of block concrete chimney, quite common in European construction but hitherto unknown on this side of the ocean, has been completed for the Canadian Pacific Ry. in its yards at East Toronto, Canada. The chimney was built according to the Monoyer system, in which the shaft is made up of segmental concrete blocks, each block being one side of the octagonal chimney section. The blocks are furthermore of special design in that they are provided with a hook at the end which, overlapping the blocks on the adjoining side, forms not only a vertical opening for the vertical reinforcement, but also an ornamental corner which adds to the architectural appearance of the chimney. Each block is reinforced in itself, but the reinforcement of the chimney consists in the vertical rods placed in the corner chambers which are incased in the concrete filled into these chambers after the blocks are in place, and also in horizontal banding reinforcement made up of rods set into grooves at each block joint.

The base of the chimney is a solid concrete slab but the subfoundation is somewhat out of the ordinary in that it consists of circumferential concrete retaining walls of gravity section, with an earth fill in the middle capped with a concrete floor. One of the details in Fig. 1 shows this plainly. Out of these annular base rings project vertical rods which are tied into the vertical reinforcing of the chimney proper.

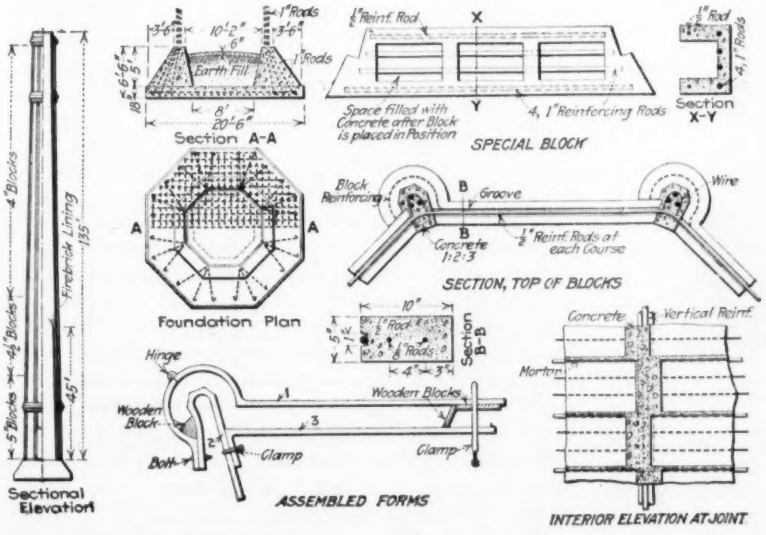


FIG. 1. MONNOYER TYPE CONCRETE BLOCK CHIMNEY, USED ON CANADIAN PACIFIC RY. WORK IN TORONTO, CANADA

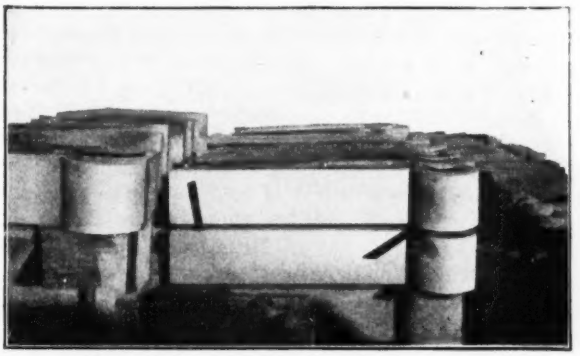


FIG. 2. THE BLOCKS WERE READILY PILED UP IN NEARBY YARDS

The blocks are made in metal forms, shown also in the detail in Fig. 1. These forms consists of three parts. Parts 1 and 2 are bolted together and part 3 placed at a distance to insure the proper thickness of the block, and fastened to the others by means of two clamps, one at the top and one at the bottom. Wooden blocks are then put in to give the required length, and the two other parts are secured together by a large clamp. A wooden block is also placed in the nose of the hook, giving a flat surface there. These forms are adjustable, and make blocks of all sizes. In the Canadian chimney, for instance, the blocks required are noted in dimension and number in the table on p. 76.

The blocks are cast on the job. In the Canadian chimney three men turned out in the neighborhood of 65 blocks daily. When the forms were set up, a 2 in. face of a 1:2 mortar was pressed against the face of the forms with the hand, then 3 in. of 1:2:3 concrete, mixed quite dry, was rammed into the form, a horizontal reinforcing rod placed, 3 in. more of concrete and another rod placed, and then the block carried up to the top of the form. A ½-in. layer of the concrete is then scraped off the top of the form, and a layer of mortar substituted. A groove 1 in. wide and ½ in. deep is then made along the upper surface of the block to provide a place for the horizontal reinforcing rods in the chimney. The blocks are allowed to stand for a couple of days, are then piled in rows (Fig. 2) and left for ten days to two weeks before using.

Some blocks are made with a hook on the right and others with a hook on the left. On the Canadian chimney, two courses of ornamental special blocks, of the design shown also in Fig. 1, were used. These are wider than the general blocks and have a series of cells which may be noted in the detail, which are filled with concrete when the block is put in place.

How the Blocks Are Placed

In placing the blocks in the chimney they were carried up in courses. The horizontal rods were placed in the grooves, and the concrete filling in the corner joints along with the block courses, each alternate row having the hooks on the opposite side of the preceding row and each hook being placed over the hook immediately below it. After about five courses were laid up

from the ground, a scaffold was erected on the inside of the chimney, from which the blocks were hoisted. A gasoline engine placed outside the chimney was used for this operation, and openings were left in the foundation to enable the cable to pass through. The blocks were carried to an opening left in the ground level for the purpose of cleaning out the chimney, and then attached to the cable. This method of hoisting blocks and concrete was continued until the chimney was completed. Two masons and five helpers laid nine courses daily, or about 72 blocks, and the work progressed very systematically because of the absence of any delay on account

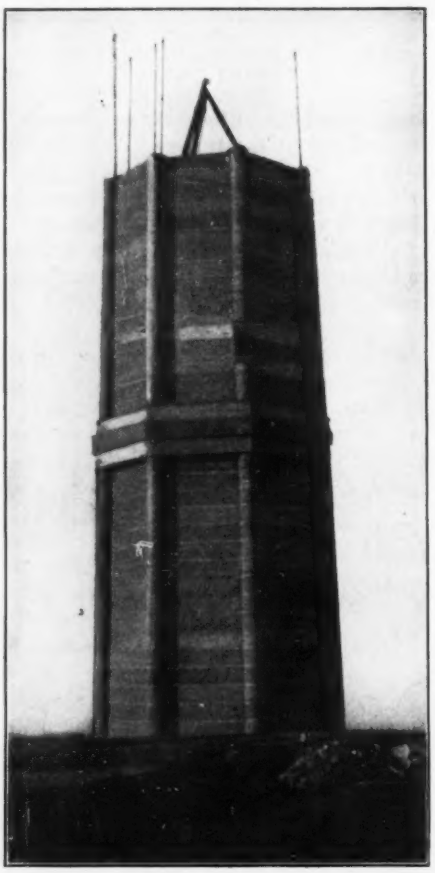


FIG. 3. LOWER PART OF CHIMNEY SHOWS ANNULAR BLOCKS AND SPECIAL COPING BLOCKS

of weather conditions. The men could make blocks under sheds at any time.

The Canadian chimney was 135 ft. high, had an inside top diameter of 5 ft. 6 in., and an inside bottom diameter of 10 ft. 2 in. It was lined on the inside with 4 in. of firebrick set in fire clay, carried up to a height of 45 ft. from the foundation. It cost in the neighborhood of $3000. The work was done by the firm of Ed. Pelletier & Sons, of Quebec, who have the rights for Canada and the United States. The writer was superintendent of construction for the Canadian Pacific Ry.

BILL OF BLOCKS

Thickness In.	Length Ft.	Length In.	Quantity Left	Quantity Right
5	4	3	40	32
5	4	1	24	24
5	3	11	40	40
4½	3	9	40	40
4½	3	7	40	40
4½	3	5½	40	40
4	3	4	40	40
4	3	2	40	40
4	3	0	40	40
4	2	10½	40	40
4	2	8	40	40
4	2	6½	40	40
4	2	4	32	24
4	2	3	40	40
4	2	1	32	32
			568	552
Total			1,120	

Distribution of Pumpage in Force Mains and Laterals

Chart Illustrating Flow-Distribution Survey Made by Pitometers at St. Louis Water-Works Will Repay Study

By F. L. Bock
Formerly Assistant Engineer in Charge Distribution Section, Water Division, St. Louis, Mo.

THE accompanying chart illustrates a method of showing the flow in pump lines and laterals of a water-works pipe distributing system. It was devised by the writer to summarize the results of a flow-distribution survey by pitometers.

The survey was conducted in St. Louis during the summer of 1916 on the pump lines of the Baden pumping station, which pumps water at 125 lb. pressure to reach the higher elevations and supplies about 40% of the entire consumption. This survey was intended to serve two purposes: (1) To show the distribution of flow and (2) to determine the friction loss in various sections of the four 36-in. force mains as they radiate from the station. For the latter purpose it was expedient to treat each line by sections and to select the observation points as far apart as possible so as to secure the pressure losses over long stretches of pipe; but so arranged as not to interrupt service from the laterals off the section under test, when they are closed. The results of the friction-flow tests are incomplete and are omitted here.

PUMP LINE NO. 8, WITH TWO BRANCHES

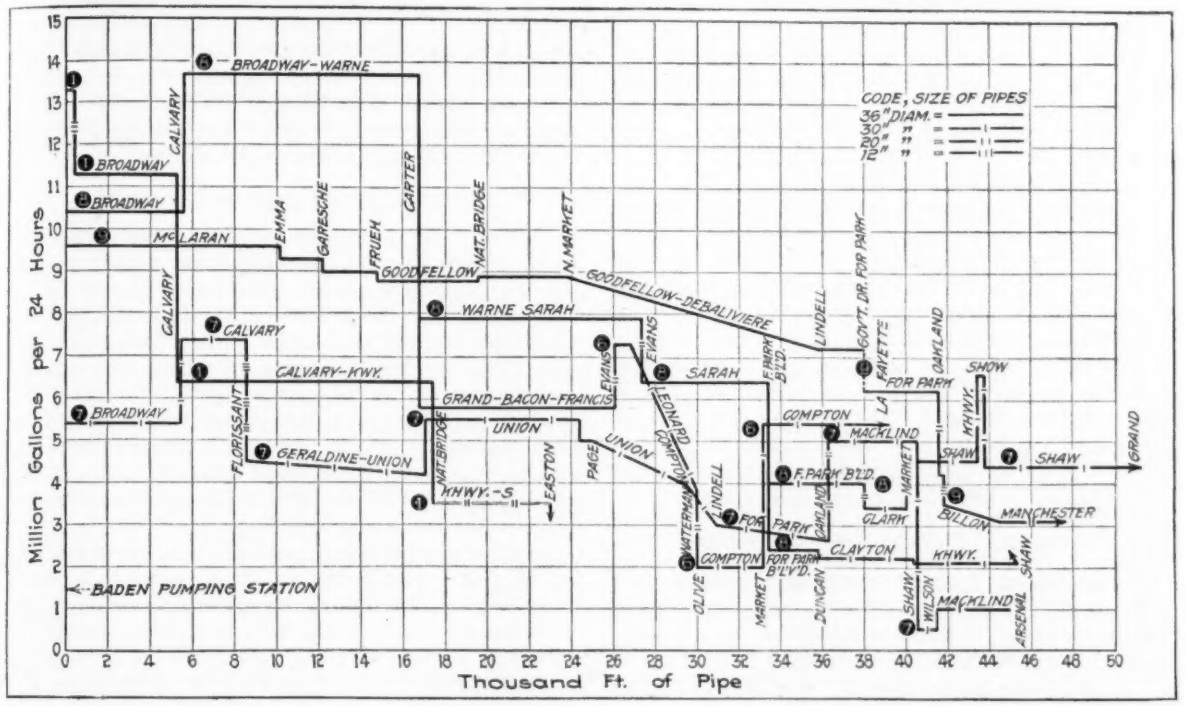
Pipe Diameter, In.	Distance, Thousand Ft. of Pipe	Flow, Million Gal. per Day	Route of Line or Location of Branch or Lateral
36	0.0 to 5.6	10.4	Along Broadway to Calvary
36	5.6 to 5.6	+3.3	Lateral at Calvary
36	5.6 to 16.8	13.7	Along Broadway and Warne to Carter
36	16.8 to 16.8	—5.8	Branch at Carter along Carter, Grand, etc.*
36	16.8 to 27.4	7.9	Along Warne and Sarah to Evans
20	27.4 to 27.4	—1.5	Lateral at Evans†
36	27.4 to 33.4	6.4	Along Sarah to Forest Park Boulevard
30	33.4 to 33.4	—4.0	Branch at Forest Park along Forest Park, Clark and Market*
36	33.4 to 35.8	2.4	Along Forest Park and Boyle to Duncan
12	35.8 to 35.8	—0.2	Lateral at Duncan
30	35.8 to 40.4	2.2	Along Shaw to Kingshighway
12	40.4 to 40.4	—0.1	Lateral at Kingshighway
30	40.4 to 45.3	2.1	Along Kingshighway to Shaw
36	16.8 to 26.1	5.8	Along Carter, Grand, Bacon, Francis to Evans*
20	26.1 to 26.1	+1.5	Lateral at Evans†
36	26.1 to 26.8	7.3	Along Francis, etc., to Leonard
X	26.8 to 30.0	—3.5	Several laterals along Leonard, Compton to Olive
20	30.0 to 30.0	—1.8	Lateral at Olive
30	30.0 to 33.2	2.0	Along Compton to Market
30	33.2 to 33.2	+3.4	Branch at Market‡
30	33.2 to 38.8	5.4	Along Compton to Lafayette
30	33.4 to 38.0	4.0	Along Forest Park and Clark to Theresa*
20	38.0 to 38.0	—0.6	Lateral at Theresa
30	38.0 to 40.0	3.4	Along Clark and Market to Compton‡

* Branches as distinguished from laterals—being 30 in. and over, much longer and equal in importance to pump lines. † Another point where main line runs into branch (*). ‡ Point where second (*) branch runs into first (*) branch.
The flow added to or deducted from main-line flow through branches and laterals is indicated by positive or negative sign, so that adding or subtracting the branch or lateral flow from the previous main-line flow gives the succeeding value of main pump-line flow.

The observations for each section consisted of flow and pressure records at each end and midway for check and were continuous over a four-day period. The first two days gave the normal flow conditions, of which the flow records supplied the data for the accompanying chart, while the records of the last two days were secured with all laterals closed, so that the flow would be the same throughout the section under test.

The table on the preceding page will illustrate in a brief way the intended manner of following one of these lines in the chart.

This chart, constructed some months ago, shows a total of 38.7 million gallons leaving the Baden station each day, which quantity is practically identical with the average daily pumping from the Baden station of 38.8 millions for the fiscal year just ended Apr. 1, 1917.



DAILY FLOW THROUGH BADEN FORCE MAINS, ST. LOUIS WATER-WORKS—WATER-WORKS PROPORTIONED TO DAILY CONSUMPTION OF 100,000,000 GAL.

Since this survey extended over the summer months, a period of considerable daily variation in pumping, it was necessary to adopt some method to reduce the daily-flow records to a common basis for charting. For simplicity it was assumed that the daily flow at any point along a pump line was proportional to the total daily consumption. The average daily consumption for the entire city during the past year was 98 million gallons, but for convenience of comparison with other yearly averages all flows were reduced to a basis of 100 millions total. For instance, a day's flow of 11 millions recorded at some point when the total consumption for that day was 110 millions would be multiplied by the ratio (100 divided by 110), giving a value of 10 millions for charting in place of 11 as recorded.

The appended chart is formed by plotting as ordinates the daily flow (reduced as described) at various points along the pump line and as abscissas the length of pipe measured from the pumping station to the corresponding points. The pipe sizes of the various pump lines and the larger branches and laterals in the various sections are represented by a code of lines. The streets along which the pump lines and branches extend are given horizontally over the code lines, and those locating the laterals are given on the vertical code lines representing the larger laterals.

This scheme is not expected to give nearly the accuracy that the foregoing results indicate, but is presented as an approximation close enough for practical use to design changes in piping systems.

Asphalt Industry Prosperous

Statistics just completed under the supervision of J. D. Northrop, of the United States Geological Survey, Department of the Interior, indicate that for the year 1916 the quantity of natural asphalt, including bituminous rock, grahamite, gilsonite, wurtzilite, and the natural paraffin, ozokerite, produced and sold at mines and quarries in the United States was 98,477 short tons, a gain of 22,726 tons, or 30% in quantity compared with 1915. Ozokerite from domestic sources reappeared in the statistics of production for the first time since 1907. The quantity of manufactured asphalt produced in 1916 from crude petroleum of domestic origin increased only 3½% as compared with that produced in 1915, and the quantity of similar material manufactured in this country from Mexican petroleum increased 47% as a consequence of which the net gain over production in 1915 was nearly 20%. California led all other states in the production of manufactured asphalt, its output from 16 refineries in 1916 amounting to 257,930 short tons.

Dragline Makes Heavy Railroad Cut Through Cleveland

Four-Track Depressed Roadbed of the Nickel Plate, Planned as Hydraulic Excavation, Is Being Graded in Two Sections by a Machine Having an Output of 300 Cubic Yards per Hour

WORKING across streets and electric-car lines and beneath overhead wires—conditions usually considered unfavorable to such operations—a 5-yd. dragline excavator is making a 750,000-yd. cut 13,000 ft. long through the southwestern part of Cleveland for the New York, Chicago & St. Louis (Nickel Plate) R.R. Temporary bridges are put in behind the machine, car tracks will be detoured, and one or two short sections will be skipped and excavated from tracks on the floor of the cut. To be of four-track width, a cut is first being excavated only for the two north tracks, loading cars on the surface on a temporary track next the existing main. When the tracks in the cut are in operation, the south portion will be taken out, loading trains on the lower level. The dragline offers the advantages of a large output, more than 300 yd. an hour, combined with ability to load on either level, which permits trains to be switched past it in loading.

Hydraulic Method First Proposed

The cut extends from Walworth Run, a deep valley at the east end, to West 96th St. and Detroit Ave. The maximum cut is near the middle of the section, a depth of about 25 ft. being removed at West 65th St. Of the 26 streets which crossed the railroad at grade within this distance, one-half, including two streets with electric-car lines, will be carried across the cut on bridges, the rest of the crossings being abandoned.

It was at first planned to make the excavation by sluicing with a hydraulic giant, beginning at the east end and washing the material into Walworth Run. However, sufficient water to carry out such operations could not be secured except from the city, and the city would be unable to furnish it until the completion of its new intake and filter plant. On this account the work was delayed until the railroad changed hands, and it became desirable to use the dirt excavated from this cut in large fills being made on the east side of the city instead of wasting it in the valley. As it thus became necessary to load the excavation into cars, the choice for excavating equipment fell on the dragline.

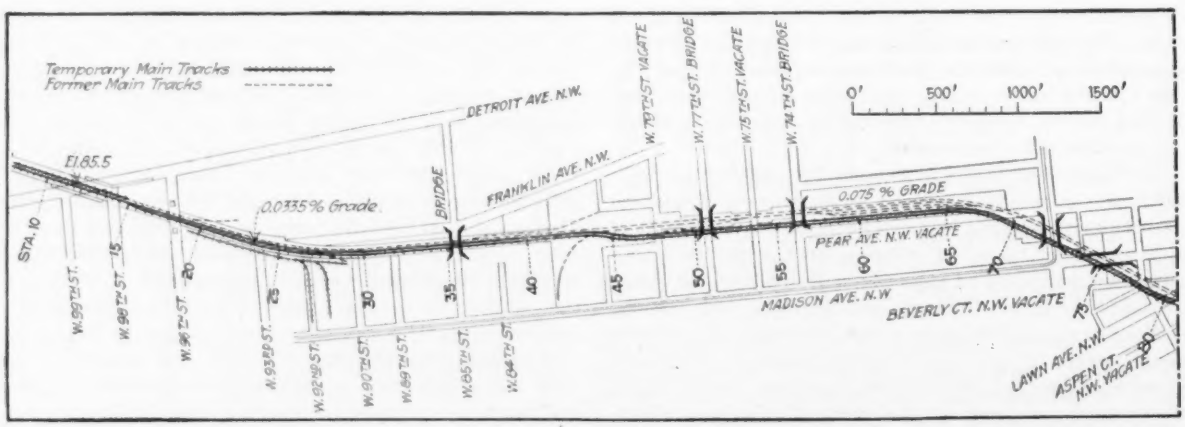
Work Well Adapted to Dragline

This machine is said to possess numerous advantages for the work in hand. Since it could readily load at the original ground surface, using an extra track on the old right-of-way, it was possible to handle a long train of dump-cars past the machine with no delay for loading. This could not be done of course in supplying cars to a steam shovel on the floor of the cut working against the face. Because it was necessary to pass two lines of street-car tracks, a shovel of sufficient size to load cars on the bank from the floor of the cut could not have been carried through from one end to the other without dismantling.

As all of the excavation was disposed of east of the work, to have made the cut from both ends would have doubled the excavating equipment required and increased the length of the haul, probably necessitating extra locomotives. Working directly on the surface, the dragline excavator moves over street intersections and car tracks without any delay. Equipped with a 5-yd. bucket, it has a very large output, and it is an easy matter to give it a continuous supply of empty cars. On one occasion it loaded 209 cars averaging 15½ yd. place measurement in 11½ hours.

20-Car Dump Trains

About 80 dump-cars are used, handled in 20-car trains. Five locomotives belonging to the contractor and one or two of the railroad's are employed, some of the grades on the temporary track at the dumps



HEAVY CUT THROUGH CITY MADE IN HALVES BY EXCAVATING EQUIPMENT USED HERETOFORE ONLY IN

requiring pusher service. Although most of the excavation is being carried to the east side, about 150,000 yd. is being used to make a fill for the city along the line of Walworth Ave. south of the work at its east end.

In order not to interfere with operation or to occupy more right-of-way than needed for the new cut, the north side of the right-of-way was excavated first to make a two-track cut, shifting the existing tracks to the extreme south of the right-of-way where this was necessary over the west part of the line. The dragline averages about two and a half 30-ft. moves a day on this cut. All cross-streets are being shut off as the machine reaches them, temporary bridges of timber being constructed across the first cut at those streets where permanent bridges are not to be located.

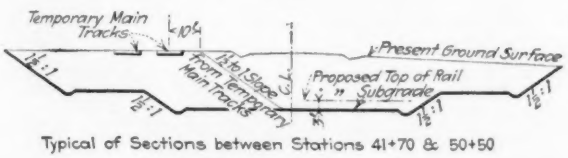
Small Section Left for Steam Shovel

The machine was taken past 58th St. and this temporary bridge constructed, with the intention of delivering the Lorain Ave. car tracks across it and closing Lorain Ave. itself until the cut past it had been completed. It was not possible, however, to secure the special track equipment required in time to make this shift, and it was necessary to skip this section with the dragline, leaving about 12,000 yd. to be taken out by steam shovel. Later, when this track equipment arrived and traffic was diverted to the 58th St. bridge, the steam shovel was started down to working level from an incline on the south side of the cut. About five separate cuts, loading first on the ground surface, next in the first cut, then on the lower level, will be required to work through the section.

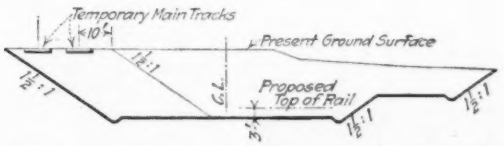
With West 65th St., however, it was not possible to detour the car tracks, and the machine was moved across this street, leaving this spot to be excavated later from the floor of the cut. A detour is now being built so that this section can be excavated. This work will have to be done with clamshell buckets, working from both the original level and the floor of the cut, because of two large water mains which it is necessary to keep in service.

Only two other places on the entire line had to be so left. One of them was where some overhead wires that could not be moved interfered with operating the big machine. The small amount of excavation left here was cleaned up by a locomotive crane with a grab bucket on the floor of the cut. The other place was on the approach grade at the extreme east end of the cut, which was excavated by a steam shovel.

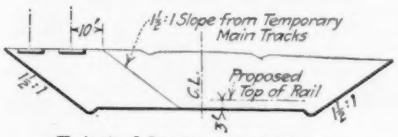
The crossing at West 65th St. was the only one, however, where pipe lines were supported during construction, although there are a water main and a sewer at nearly every intersection. The only other unusual construction was required at West 55th St., where a 4 x 5-ft. brick sewer was reconstructed in tunnel 40 ft. below the surface. This sewer, constructed from Walworth Ave. to the low level, will be carried as far west as West 85th St. and as far east as West 42nd St., intercepting all the sanitary sewers between. When the tunnel reached the southerly side of the right-of-way in 55th St., a cave-in occurred, and the remaining length is being completed in open cut. This made it necessary to drive 40-ft. piles to carry the two present main-line tracks at this point.



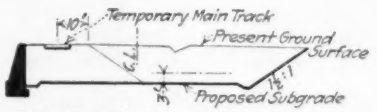
Typical of Sections between Stations 41+70 & 50+50



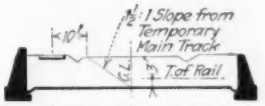
Typical of Sections between Stations 58 & 71, 112 & 119+50



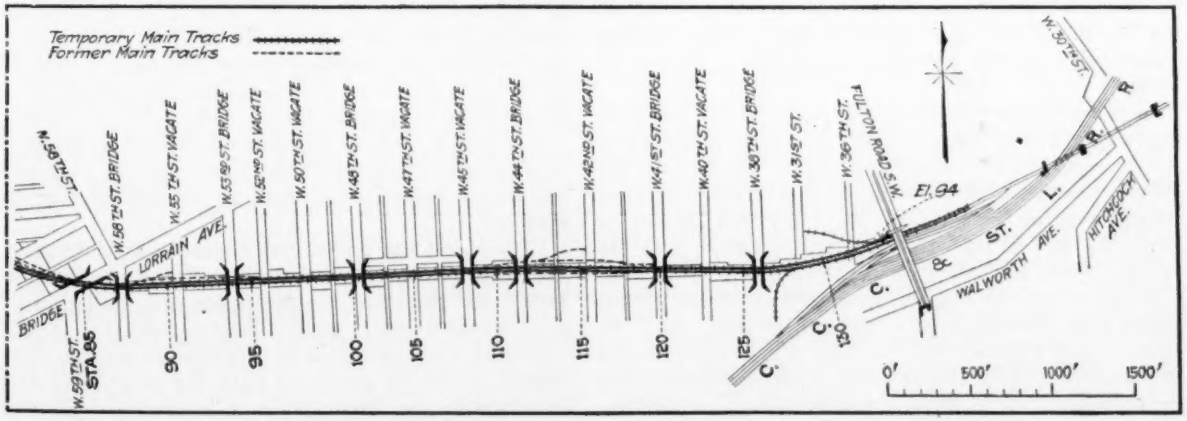
Typical of Sections between Stations 15 & 17+50, 22+50 & 28, 34 & 36+70, 50+50 & 58, 71 & 112, 119+50 & 139



Typical of Sections between Stations 28 & 29+50, 32 & 34, 36+20 & 38+25



Typical of Sections between Stations 17+50 & 22+50, 29+50 & 32 38+25 & 41+70

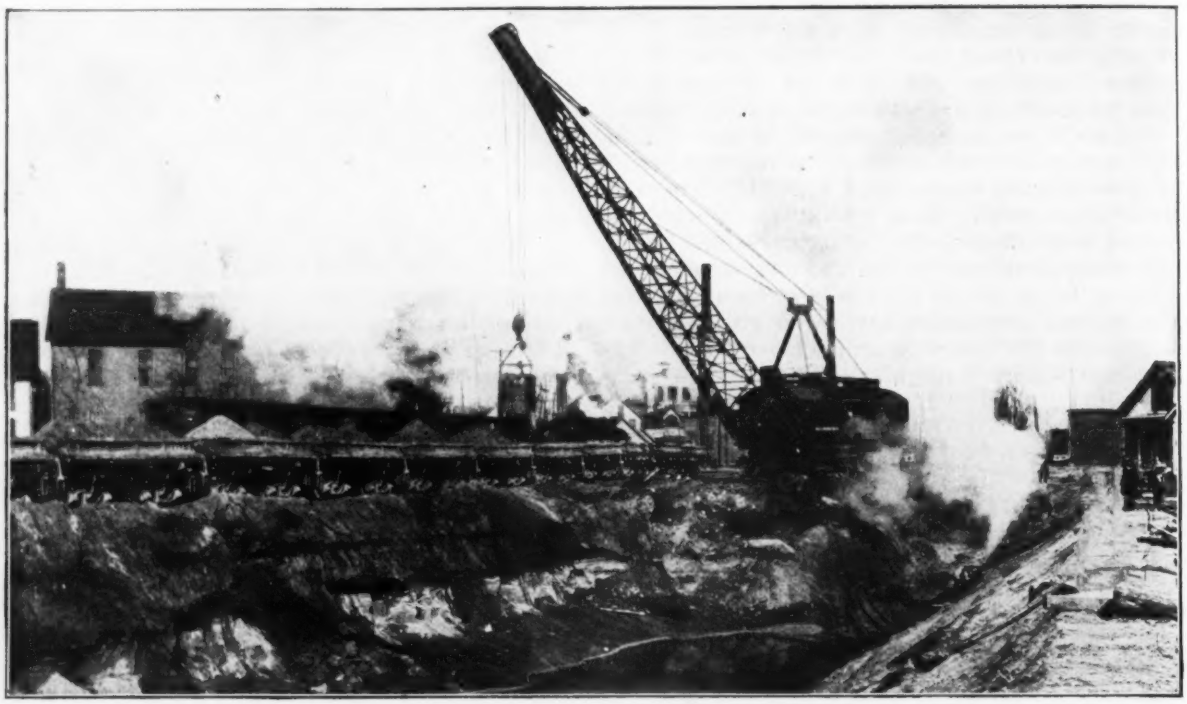


OPEN COUNTRY, STREETS BEING SHUT OFF ONE BY ONE AND REOPENED BEHIND THE HUGE DRAGLINE

After reaching the west end of the work, the dragline will move over to the south side of the right-of-way and take out the remainder of the cut, proceeding east. As work progresses on the first part of the cut, the tracks for the new main line are being laid and ballasted, and traffic will be diverted to them before the second part of the excavation is begun. The old main-line tracks will be taken up and the disposal trains loaded on the south track in the cut. The process of shutting off and restoring the streets will be followed out in the inverse order described above, except that permanent structures will be built instead of timber ones.

Masonry Just Started

A start has already been made on the masonry for these crossings along the north side of the first cut.



FLOOR OF CUT WOULD HAVE BEEN TOO SOFT FOR STEAM SHOVELS—DRAGLINE DIGS 300 YARDS AN HOUR

The first street retaining walls built were concreted with a track mixer operated on a short spur built across to the work, but it is expected that a track mixing plant will be put in operation from the floor of the cut later.

The excavation with the dragline, including the operation of the dirt trains and the handling of the extra track required, is being done under contract by the Walsh Construction Co. All the other work, including the permanent track laying, the excavation carried on with the locomotive crane and steam shovel, and the bridge work and other work necessitated by cutting off the streets, is being done by forces of the Nickel Plate R.R., for which W. J. Bergen, assistant to E. E. Hart, chief engineer of the New York, Chicago and St. Louis R.R. is in charge of all grade separation work in Cleveland. A. C. Harvey, field engineer, is in charge of the improvement for the railroad.

Gives Eight Objects of Engineer's License Law

Prof. Clarence T. Johnson, in Michigan Technic, Holds That Reasonable Law Would Benefit Profession and Public

There are at least eight "objects of a reasonable and just law for licensing engineers," according to a recent article by Prof. Clarence T. Johnson in the *Michigan Technic*. These objects, with special comment on the eight, are as follows: "(1) To lay a foundation upon which a civil-engineering profession may rest; (2) to have a public record of the training and experience of each civil engineer who is entitled to practice within the state; (3) to protect every practitioner who is of value to the community in which he lives; (4) to provide a complete list of the civil engineers engaged in practice within the state; (5) to bring all of these men together in one body in so far as their support may be needed on any question concerning their profession or public business of a civil-engineering kind; (6) to arouse their general interest in matters of government; (7) to enable them to lend general support to the engineering administration of the state; and (8) to gradually obtain control of all work in the field of the civil engineer.

"The object last stated may appear of trivial importance or it may seem to embrace something of selfishness. This is not the case. No profession can develop to the point where it enjoys general respect until it is in position to control the field it is presumed to occupy. This respect cannot be developed until the practice of civil engineering is so regulated as to insure the realization of the objects enumerated above."

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Cannot Make Shipmen of Ordinary Carpenters Overnight

Sir—In these days when shipbuilding is to the forefront and so many engineering concerns are taking up this line, it might be well to sound a note of warning, particularly in the matter of wooden ships.

While the field of industrial engineering admits of a large degree of standardization, the building of a wooden ship has always demanded and always must call for a large amount of skilled, experienced labor. The supply of such labor on the Atlantic Coast is limited, and in consequence grave danger of loss is incurred by concerns taking over lump-sum contracts for wooden vessels, as a large proportion of the work on such vessels cannot be machined.

To all such concerns I would say, "Make sure your skilled labor is available and make ample allowance for the increased wages you will have to pay."

Do not for an instant imagine that you can turn ordinary carpenters into shipmen overnight.

J. W. RICHARDSON,
Superintendent of Ship Alterations and Repairs.
New York City.

Military-Road Promotion Censured

Sir—It was a great satisfaction to read your vigorous editorial of June 7, entitled "Military Strategy and the Good Roads Propaganda." I have come directly in contact with a local outcropping of this movement. Some little time ago I received a letter from one who subscribes himself as secretary of "The Pacific Coast Defense League," asking me to give him a letter in support of the aims of the league, which he could "use in presenting our plan before Congress."

The letter very naïvely stated that the sole purpose of this high-sounding organization was the "construction of a military road from the Canadian to the Mexican border." Some of the chief promoters of the project propose that the route lie practically all the way along the immediate coast line. Your sarcastic exposure of the stupidity of such a scheme, as a military measure, is none too strongly put. Your remark that rail transportation is "infinitely cheaper and more efficient than the highway" is especially pertinent to the present case. But of course, matters of this sort are a subject of entire indifference to the promoters of the project, who are not at all concerned about the defense of this coast, but want a fine automobile excursion route over this great distance opened up and built at the expense of the Government.

The hopeless feature of all these movements is seen in the low grade of patriotism which they disclose. Men of business standing put themselves behind local schemes under the false pretense of military necessity and seek to take advantage of the present high tension of public feeling to commit the Government to policies that it could never be induced to adopt in less strenuous times. It should be the duty of the directors of the public press and of the level-headed molders of public opinion, unmercifully to expose and denounce these selfish and unpatriotic efforts to bleed the Government for local interest when it is already carrying as great a burden as it can bear. Your timely editorial sets an excellent example in this respect.

H. M. CHITTENDEN,
Seattle, Wash. Brigadier General, U. S. A. (Ret.).

The Rewards of Public Service

Sir—I have just read with considerable regret, in a recent issue, of the resignation of William H. Connell as Chief of the Bureau of Highways of Philadelphia. Having had opportunity to know something of the results accomplished in that city by Mr. Connell and having also had personal experience of what seems to be the probable fate of anyone who attempts, while serving under an elected head, to try to secure in a public organization something like the efficiency demanded in a private one, I can appreciate as strongly as any the setback which his severance from the Philadelphia government will effect in the slow attempt to bring our municipal highway departments out of politics. Two years ago, the advances which Commissioner Rourke was making to bring the Public Works Department of Boston out of the mire of politics came to a similar untimely end. Our municipal public service is the poorer by the loss of these men.

As long as conditions in our municipalities make it possible to so hamper engineers in executive authority that competent men will not stay, or while (as has been within my own experience) irrespective of the value of the services rendered, they find it desirable to move on to provide a place for deserving relatives, or because they do not control as many votes as others, there will be little but academic interest in a great deal of the discussion that crops up from to time in engineering papers and at our numerous conventions as to the best type of organization for engineering public work.

New York City. HENRY WELLES DURHAM.

Claims Hydrated Lime Permits Detection of Undermixed Concrete

Sir—I am much interested in Mr. Harrison's letter on the consistency of concrete, in *Engineering News-Record* of June 7, 1917, p. 516, and cannot help but agree with him in many of his statements. He states, however, that undermixing and the use of hydrated lime are poor practice. It is not my intention to defend undermixing, because this must be considered poor practice whether the mixture contains lime or not and should be discouraged at every opportunity. The inference may be drawn from Mr. Harrison's conclusion that the use of hydrated lime will permit the concrete to be undermixed with less possibility of detection than when lime is not used. This, however, does not work out in actual practice, as certain engineers are specifying and using hydrated lime for no other reason than quickly detecting undermixing.

Hydrated lime is a very white material and, unless given a reasonable amount of mixing, the mixture as it

comes from the mixer will show white streaks so the inspector can quickly determine at a glance whether or not the concrete has received a reasonable amount of mixing. This, therefore, gives hydrated lime an added advantage.

When small percentages of hydrated lime are used in concrete mixtures, the consistency is greatly improved, as the lime introduces so-called lubrication into the mixture which causes it to flow freely through the spouts, or from carts, with a minimum quantity of mixing water. The question of using excess water is one that does not enter the contractor's mind until such time as he finds that the concrete will not flow freely or cannot be easily spaded. In other words, if he finds that the mixture cannot be placed most economically, he then begins to add excess water, which, of course, tends to decrease rapidly the strength of the resulting concrete as a result of segregation.

By eliminating the cause for the use of excess water through the introduction of plasticity into the mixture, hydrated lime improves the consistency by having concrete most economically placed and with maximum strength.

It is not, however, the idea of this letter to convey the impression that small percentages of hydrated lime will correct the shortcomings of undermixing or other conditions arising as a result of poor workmanship.

NORMAN G. HOUGH,
Manager, Hydrated Lime Bureau.

Pittsburgh, Penn.

Automobile Operating Costs

Sir—I note with interest the table of automobile operation costs printed on page 439 of the May 31 issue of the *News-Record*. This table is worthy of comment in a number of particulars, but especially on account of the fact that a wrong impression of the Ford car is likely to be created by these statistics.

Thus, it is interesting to note that a depreciation charge of only $95 is made against a Hupp, that has run 3000 miles, whereas a Ford, driven about twice as far, but worth less than half as much, is charged up with a depreciation of $160.30. Now this is absurdly more than the actual depreciation on a Ford, if judged on a mileage basis; for it assumes that a Ford will run only about 20,000 miles, when, as a matter of fact, it will, with ordinary care, run at least four or five times that far.

On the other hand, if the depreciation shown was based on sale value at the time the depreciation was estimated, the figure for the Ford is about correct, while the figure for the Hupp, on this basis, is at least $200 too low.

The depreciation per mile is, of course, equally in error. Depreciation on a Buick that has run 37,403 miles (no present value given) is figured at $0.0203 per mile, while the depreciation per mile for the Ford is given at $0.0256 and for the Hupp at $0.0323. But the Ford costs only about half as much as the Buick and less than half as much as the Hupp. Moreover, the long service life of the Ford cars is universally recognized. Therefore, to assert such a depreciation per mile for the Ford can be possible only where the car is abused, in which case the figures are not representative and should not, in justice to the Ford car, be printed without a statement to that effect.

Another matter that, if true, shows wonderfully poor management of the Ford car is the relative cost per mile for casings, which is here recorded as practically the same for Buick, Ford and Hupp cars. The Ford car is so much lighter than the 1916 Hupp that the very suggestion of equal tire cost on these two cars is ridiculous.

A similar charge might be leveled at the "total cost per mile" figures, which show a cost of only $0.01 more for the Hupp than for the Ford. This could only be true where a Ford is so poorly handled that costs shown are wholly unrepresentative.

These comments are principally based on comparisons of the Ford cars and the Hupp cars, because the writer is thoroughly familiar with these machines. Both are good machines, and both have their legitimate fields; but to present figures as authentic which pretend to show that a Ford car will cost almost as much per mile run as a Hupp only serves to throw question on every figure presented.

The accumulation of cost data is a valuable thing—if it produces facts—but when it produces a conclusion that operating a Ford car costs about as much as operating a Hupp, either the cost records should be quietly removed from the premises or else the garage foreman should be fired before dark.

J. L. HARRISON,
Civil Engineer.

Falls Church, Va.

Women Draftsmen

Sir—Referring to C. E. Newell's letter published in *Engineering News-Record* of May 31, p. 469, and Joseph Webb's letter appearing in the issue of June 14, p. 564, Mr. Newell's letter would be more convincing if he would explain just why it is that, if "a large percentage of this work is purely a matter of routine" and if "it would take no lengthy or elaborate preparation" for the ladies to qualify as draftsmen, a man is expected to have a technical education before being able to hold down a drawing board.

Mr. Webb's comparison of the relative standing of engineers and day laborers would seem to indicate that in his opinion the duties of a civil engineer require about the same qualifications as those of a day laborer.

There seems to be but one conclusion to draw from these letters (assuming that these gentlemen have given us their honest opinions), and that is that their training and experience have not been such as to qualify them to be competent judges of the compensation due those engaged in engineering work.

Kansas City, Mo. ——— ———.

Sir—Permit me to make the following answer in your columns to the letter by C. E. Newell, Southern Ry. Co., May 31, and Joseph Webb, Chesapeake & Ohio Ry., June 14, on the subject of women draftsmen.

It appears from the advertisement quoted in Mr. Webb's letter that he is comparing engineers and draftsmen to Italian or Mexican track laborers, for such alone can be obtained today at a salary of $3 per day. I can hardly conclude that he is conversant with the present condition of the labor and materials market and the cost of living.

Is the gentleman aware of the time and cost of education a technically skilled draftsman or engineer re-

quires to place himself in the field ready for the abuse and misuse by a professionally uneducated employer, that he compares him to a railway-track laborer whose sole cost of education is a bare daily existence and whose intelligence amounts to the more or less skillful use of the pick and shovel?

And gentlemen, you ask for a cheaper class of labor to do your engineering. I cannot conceive of such a statement as emanating from engineers. Are you aware that the United States engineer of today must design and construct with due regard to public safety, which is his initial duty to the people, his profession and himself, and that this end, which is true economy, can be arrived at only through a higher grade of office and field help? ——— ———.

Chicago, Ill.

[We intentionally omit the signatures from these two letters. We believe that, if their authors will read Mr. Webb's letter again, they will perceive that it was written entirely in irony and will be glad that we have withheld their names. Evidently, Mr. Webb is as much disturbed as they are at the prospect of having women supplant men at the drawing board and beat down the prices for such work. His comparison of engineers and day laborers, if our interpretation is correct, is set forth in scorn. It is not that he counts the two classes of only equal value, but that, alas, many employers do!

At the same time it is possible to entertain Mr. Newell's original suggestion without belittling the engineering profession. Perhaps it was unfair to the women to imply that the only reason they could qualify as draftsmen is that the work is mostly routine. Certain it is that much work in a large drafting office, particularly a railroad office, could be done by persons without technical training. Probably the reason employers prefer candidates with technical educations is that they want them to develop to something more than draftsmen. Women can serve as draftsmen, with no great future ahead of them, and still fare as well as in most lines open to them. When untrained men—and this does not apply at all to the occasional man who by sheer ability and diligence gets to the front without a technical education—once get into engineering service and do the elementary work as well as the college man, humanity demands that they be boosted along to a certain point; and there they halt, thus impeding better-trained men. The employing of women draftsmen would, we suspect, keep such men out of the service entirely and thereby help and not hinder young men with real engineering possibilities.—Editor.]

Bituminous Foundations for Sheet Asphalt Surfaces

Sir—Referring to the article "Bituminous Foundations for Sheet Asphalt Surfaces," by Mr. Kirschbraun, in *Engineering News-Record* for June 21, p. 591, I submit the following statement:

The writer has supervised the construction of a considerable area of street pavement, largely sheet asphalt, and has observed the action under traffic for several years of these and other pavements of similar character. In some cases a concrete base was used; in others, the base was of macadam or crushed stone. My experience and observation have demonstrated conclusively that a good cement-concrete base is more satisfactory than a less rigid or more elastic one.

In this city several streets were paved about eight years ago with bituminous material upon a macadam or crushed-stone base. Since the expiration of the five-year guarantee period the city has had to maintain these pavements, and we have gained considerable insight concerning the characteristics of pavements under various conditions.

On College St., where there is much traffic with heavy trucks, the pavement foundation is of old macadam. In patching this pavement two years ago we first used the city steam roller to compact the new work, but soon had to discontinue rolling. We found that the old pavement adjacent to the patch would work up and down as the roller moved, showing a yielding foundation. Since then we have made patches on this street without rolling, but the old pavement is full of bumps and depressions, due to settlement under traffic.

The recently paved streets here are of sheet asphalt upon a cement-concrete base; they are mainly in residential sections. The pavement is 7 in. in total thickness, with 4 in. of cement-concrete base, 1 in. of binder course and 2 in. of sheet asphalt. This pavement has been laid about 3½ years; it has a good surface, remarkably free from cracks or worn places.

Some of the suburban streets that were paved about seven years ago are of asphaltic concrete upon a cement-concrete base. Most of these pavements have cracked badly. These cracks are attributed to two causes: First, a deficiency of asphaltic cement in the mixture and, second, lack of sufficient traffic to keep the surface "ironed out."

Another suburban street with the same kind of pavement has developed transverse cracks at intervals of from 30 to 40 ft. for a long stretch. This condition is attributed to joints in the cement-concrete base; the joints are said to have been purposely made during construction. The cracks are stated to be directly over the joints. No explanation has been given as to why joints were made in the base.

In the writer's experience the following features have been found to be of advantage in a cement-concrete base: (1) Firm, unyielding foundation, acting as a bridge over soft spots in the sub-base; (2) freedom from injury by water or dampness.

A base of asphaltic concrete may be better than one of macadam or broken stone; it would, in my opinion, be inferior both in strength and durability to one of cement concrete. Water will in time soften and disintegrate an asphalt mixture, while it has the opposite effect on cement concrete.

With regard to the pounding or hammering by heavy traffic on an asphalt pavement upon a rigid base, any pavement will be injured and worn by traffic. Asphalt pavements will in time acquire a wavy, uneven surface under traffic, with any kind of foundation. When laid upon a cement-concrete base, they should have a good binder course next to the concrete. We have an asphaltic pavement upon a street with a 6% grade; it has a cement-concrete base. This pavement has been down for several years; it has a good surface and does not show signs of creeping on the grade. S. H. LEA,

Charlotte, N. C. City Engineer.

THE ENGINEER IN FIELD AND OFFICE

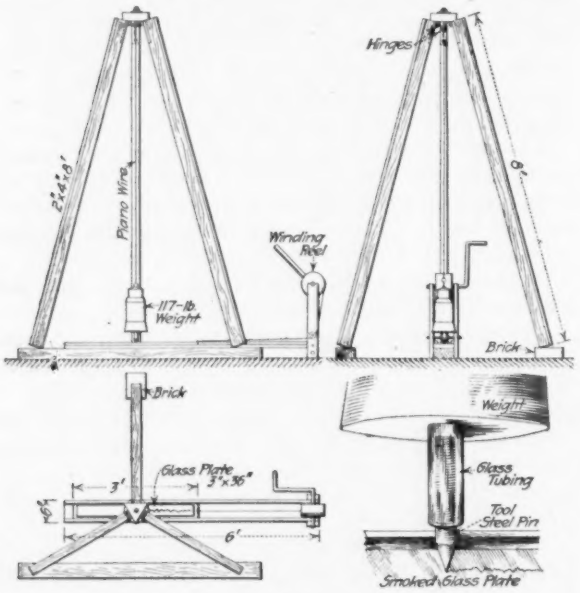
A DEPARTMENT DEVOTED TO DETAILS OF THE DAY'S WORK

Home-Made Seismograph Measures Vibration of Buildings

By S. R. Jones
Structural Engineer, J. G. White Engineering Corporation

THE measurements of vibrations occurring in industrial plants while machinery is in operation may be determined with a fair degree of approximation and with a precision certainly fine enough for engineering purposes by means of the very simple seismograph illustrated in the accompanying drawing.

The writer recently determined the severity of vibrations in a power plant with this apparatus and obtained very satisfactory results. The construction in detail



WEIGHT HUNG FROM WOODEN TRIPOD INDICATES VIBRATIONS OF BUILDING

is as follows: 2 x 4 timbers are fastened together at their tops by a triangular wooden block. Suspended from this block by means of a piece of piano wire swings a plummet of approximately 120 lb. weight. At the bottom of the weight is attached a piece of gage-glass tubing in which a stylus of small-diameter tool steel is fitted. This stylus must be so accurately fitted that, with a lubricating film of oil between it and the glass tubing, there is no lateral play. The vertical motion, however, is perfectly free. A trough is placed underneath the weight and directly on the structure, the vibration of which it is desired to measure. This trough, consisting of a board 6 ft. long by 6 in. wide with strips of wood on either side, contains a slide about 3 ft. long by 4 in. wide, which can be drawn along slowly by means of a winding reel. To this slide is attached a strip of smoked glass.

The weight, suspended by the fine flexible wire, has sufficient inertia to be unaffected by rapid vibration, and it therefore remains steady, while the smoked-glass plate underneath moves synchronously with the vibrations of the building. The effect is that of a fixed marker writing upon a moving surface. The curves obtained represent the result of two motions—that of the vibration, causing the plate to move back and forth across its main axis, and the forward movement caused by the progress of the smoked glass drawn along by the reeling device.

It is well to take the curves over periods of at least four minutes in order to register extremes that might occur due to any synchronism of the machines in the power plant.

To Keep the Back Flag Plumb

By E. P. Arneson
San Antonio, Tex.

IN MISCELLANEOUS surveying it is often necessary to leave a flag for a backsight without having the luxury of a back flagman to support it. Nine out of ten surveyors' helpers cannot plant a flag plumb. A ridiculously simple method for doing so with accuracy consists in setting the flag firmly in the ground where desired, picking up a handful of pebbles and letting one drop from the hand held near the top of the pole in the plane of backsight, then pushing the flag in the proper direction until a pebble strikes the ground near the center of the pole. The flag will then be cut squarely by the vertical hair of the instrument.

Right-of-Way Computations in Valuation Work Simplified by Table

By N. L. Sanow
Rochester, N. Y.

MANY short-cuts have been devised during the course of the computations necessary for obtaining the various right-of-way distances and data required on the maps that the railroads must submit to the Interstate Commerce Commission for the Federal valuation. The accompanying table, based upon a constant, saves considerable time. It is called the "Logarithmic Difference" table, as it is composed of the differences of two logarithms.

In computing the right-of-way distances on curves, where the stationing is measured along the center line, the distances are necessarily first measured along the center line and are then proportioned to the radii of the property lines. The formula for this proportioning is $D/D' = R/R'$, where D and D' are the distances along the right-of way and center line respectively, and R and R' the radii of the right-of-way and center-line curves. Then $D = RD'/R'$.

In most cases the measuring base is the center line of the right-of-way strip or else can be easily referred

thereto. Again, in most cases the width from center line to right-of-way line is one of five different widths—30, 33, 50, 75 or 100 feet.

Now for any one of these given widths R/R' is a constant. This constant is the base on which the table of logarithmic differences is founded. The constant is obtained by subtracting the logarithm of the center-line radius from that of the right-of-way radius for the outside curve, and the reverse operation for the inside curve. Thus for a width of 33 ft. on a 4° 45′ curve,

$$\begin{aligned} \text{Log } R + 33 &= \log 1{,}239.57 = 3.0932711 \\ \text{Log } R &= \log 1{,}206.57 = 3.0815526 \\ \text{Log difference } R+33,\ 4°\ 45'\ \text{curve} &= 0.0117186 \end{aligned}$$

The incorporation of such a table simplifies the steps greatly. Instead of having to look up two logarithms and then subtract one from the other, you merely pick from a small table the log difference corresponding to the degree of the curve and half the width of the right-of-way; and this is either added to or subtracted from the logarithm of the computed distance on the center line, depending upon whether the right-of-way line is on the outside or the inside of the curve.

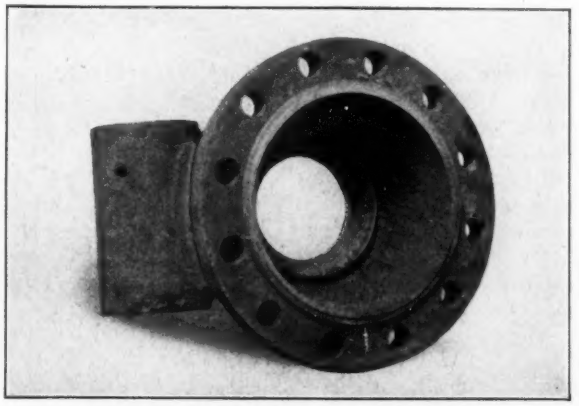
Thus, the distance on the center line is 254.90. The degree of curve is 4° 45′; width, 33 ft. each side of the center line. These are the two processes compared:

Old Method	Log-Difference Method
Log $R+33 = 3.0932711$	
Log $254.9 = 2.4063698$	
5.4996409	
Log $R = 3.0815525$	Log $254.9 = 2.4063698$
	Log difference 4° 45′, $R+33 = 0.0117186$
Log $x = 2.4180884$	Log $x = 2.4180884$
	$x = 261.787$

The table can be used to good advantage in various other problems, such as those involving property lines intersecting curved rights-of-way, wherever the ratio of the radii of center line and right-of-way line figures.

Steel Waterwheel Casting Suffers from Chemical Wear

THE Aomori Electric Co., which operates a 2000-kw. hydro-electric plant in Japan, drives its generators with impulse wheels controlled by needle nozzles. The nozzle tips, which are of cast steel, are fitted with



STEEL WORN—BRONZE UNAFFECTED

bronze inserts placed to provide a wearing surface at the orifice and the points where the needle approaches the casting. A most notable example of chemical action in the erosion of waterwheel parts appears in one of these castings, recently returned to San Francisco for replacement.

In this eroded part the steel has been worn away behind the entire circumference of the bronze insert to a depth of $\frac{3}{4}$ to $1\frac{1}{2}$ in., and this wear extends in lessening degree back to the connection between the casting and

TABLE OF LOGARITHMIC DIFFERENCES

D	R+30	R—30	R+33	R—33	R+50	R—50	R+75	R—75	R+100	R—100
0° 30′	0.0011355	0.0011385	0.0012489	0.0012525	0.0018909	0.0018991	0.0028332	0.0028517	0.0037734	0.0038065
45′	0.0017016	0.0017088	0.0018714	0.0018800	0.0028327	0.0028523	0.0042424	0.0042852	0.0056475	0.0057229
1° 0′	0.0022680	0.0022799	0.0024942	0.0025085	0.0037735	0.0038065	0.0056480	0.0057223	0.0075144	0.0076567
15′	0.0028331	0.0028518	0.0031154	0.0031380	0.0047116	0.0047634	0.0070484	0.0071648	0.0093727	0.0095796
30′	0.0033976	0.0034242	0.0037359	0.0037685	0.0056479	0.0057222	0.0084445	0.0086119	0.0112232	0.0115209
45′	0.0039612	0.0039976	0.0043553	0.0043994	0.0065820	0.0066832	0.0098360	0.0100639	0.0130657	0.0134710
2° 0′	0.0045241	0.0045717	0.0049739	0.0050315	0.0075142	0.0076464	0.0112230	0.0115207	0.0149005	0.0154299
15′	0.0050863	0.0051464	0.0055916	0.0056644	0.0084443	0.0086115	0.0126055	0.0129823	0.0167274	0.0173974
30′	0.0056475	0.0057220	0.0062084	0.0062984	0.0093723	0.0095790	0.0139836	0.0144488	0.0185465	0.0193740
45′	0.0062082	0.0062982	0.0068242	0.0069331	0.0102983	0.0105484	0.0153573	0.0159202	0.0203580	0.0213594
3° 0′	0.0067680	0.0068753	0.0074391	0.0075688	0.0112222	0.0115200	0.0167264	0.0173966	0.0221618	0.0233536
15′	0.0073272	0.0074530	0.0080532	0.0082054	0.0121442	0.0124937	0.0180914	0.0188779	0.0239581	0.0253574
30′	0.0078856	0.0080315	0.0086663	0.0088428	0.0130642	0.0134695	0.0194518	0.0203642	0.0257468	0.0273700
45′	0.0084432	0.0086106	0.0092786	0.0094811	0.0139822	0.0144474	0.0208081	0.0218554	0.0275283	0.0293920
4° 0′	0.0090000	0.0091906	0.0098898	0.0101204	0.0148981	0.0154274	0.0221597	0.0233517	0.0293021	0.0314232
15′	0.0095562	0.0097712	0.0105003	0.0107605	0.0158121	0.0164096	0.0235074	0.0248530	0.0310686	0.0334637
30′	0.0101116	0.0103526	0.0111099	0.0114015	0.0167241	0.0173939	0.0248507	0.0263594	0.0328280	0.0355138
45′	0.0106662	0.0109348	0.0117186	0.0120435	0.0176342	0.0183806	0.0261898	0.0278711	0.0345802	0.0375736
5° 0′	0.0112200	0.0115176	0.0123262	0.0126863	0.0185421	0.0193692	0.0275246	0.0293877	0.0363249	0.0396428
15′	0.0117731	0.0121011	0.0129331	0.0133300	0.0194482	0.0203600	0.0288552	0.0309096	0.0380627	0.0417217
30′	0.0123254	0.0126855	0.0135390	0.0139747	0.0203522	0.0213531	0.0301815	0.0324368	0.0397932	0.0438107
45′	0.0128770	0.0132704	0.0141439	0.0146200	0.0212543	0.0223481	0.0315037	0.0339688	0.0415166	0.0459090
6° 0′	0.0134277	0.0138562	0.0147480	0.0152664	0.0221543	0.0233455	0.0328216	0.0355064	0.0432331	0.0480176
15′	0.0139778	0.0144429	0.0153512	0.0159139	0.0230525	0.0243450	0.0341355	0.0370492	0.0449428	0.0501363
30′	0.0145270	0.0150299	0.0159534	0.0165619	0.0239486	0.0253468	0.0354452	0.0385974	0.0466454	0.0522650
45′	0.0150756	0.0156178	0.0165547	0.0172110	0.0248429	0.0263507	0.0367510	0.0401509	0.0483412	0.0544041
7° 0′	0.0156234	0.0162065	0.0171553	0.0178609	0.0257353	0.0273569	0.0380527	0.0417099	0.0500305	0.0565535
15′	0.0161704	0.0167960	0.0177549	0.0185119	0.0266257	0.0283654	0.0393504	0.0432744	0.0517129	0.0587136
30′	0.0167166	0.0173859	0.0183534	0.0191634	0.0275140	0.0293756	0.0406437	0.0448438	0.0533882	0.0608834
45′	0.0172620	0.0179766	0.0189510	0.0198158	0.0284002	0.0303881	0.0429329	0.0464187	0.0550567	0.0630637
8° 0′	0.0178068	0.0185683	0.0195480	0.0204695	0.0292849	0.0314033	0.0432186	0.0479997	0.0567192	0.0652556
15′	0.0183509	0.0191606	0.0201441	0.0211240	0.0301677	0.0324207	0.0445005	0.0495863	0.0583753	0.0674583
30′	0.0188938	0.0197534	0.0207388	0.0217790	0.0310480	0.0334397	0.0457774	0.0511775	0.0600236	0.0696707
45′	0.0194362	0.0203470	0.0213328	0.0224351	0.0319266	0.0344613	0.0470509	0.0527748	0.0616661	0.0718946
9° 0′	0.0199781	0.0209417	0.0219263	0.0230925	0.0328039	0.0354857	0.0483212	0.0543786	0.0633031	0.0741309
30′	0.0210591	0.0221326	0.0231100	0.0244091	0.0345518	0.0375401	0.0508487	0.0576017	0.0665562	0.0786349
10° 0′	0.0221367	0.0233260	0.0242895	0.0257290	0.0362915	0.0396030	0.0533599	0.0608466	0.0697828	0.0831831
30′	0.0232116	0.0245226	0.0254660	0.0270528	0.0380243	0.0416757	0.0558567	0.0641161	0.0729857	0.0877794
11° 0′	0.0242835	0.0257222	0.0266388	0.0283802	0.0397495	0.0437576	0.0583383	0.0674091	0.0761640	0.0924232
30′	0.0253521	0.0269244	0.0278078	0.0297110	0.0414670	0.0458484	0.0608045	0.0707255	0.0793175	0.0971146
12° 0′	0.0264176	0.0281292	0.0289731	0.0310450	0.0431768	0.0479481	0.0632554	0.0740654	0.0824465	0.1018544
30′	0.0274800	0.0293368	0.0301347	0.0323825	0.0448791	0.0500570	0.0656914	0.0774297	0.0855518	0.1066445
13° 0′	0.0285398	0.0305479	0.0312932	0.0337243	0.0465748	0.0521763	0.0681140	0.0808205	0.0886351	0.1114881
30′	0.0296955	0.0317608	0.0324471	0.0350685	0.0482617	0.0543032	0.0705198	0.0842334	0.0916926	0.1163800
14° 0′	0.0306487	0.0329768	0.0335988	0.0364165	0.0499418	0.0564401	0.0729121	0.0876727	0.0947282	0.1213265

the nozzle body. Proof that this cutting away of the metal was due to chemical action entirely, and not to wear, was found in the condition of the bronze insert. As soon as the steel was worn away, the inner edge of the bronze insert, which was quite sharp, stood out unprotected directly in the line of water flow; but it did not suffer the slightest wear and still retains its sharp edge, although the steel originally supporting it was cut away around the entire circumference.

The casting was in service about four months, when the wear became so excessive that renewal was necessary. When the casting was received, samples of the water were not available in San Francisco; and as no one at the plant had been able to make tests, it was not known just what the chemical was that caused the action. The remedy, however, obviously consisted in making the entire casting of bronze, and this plan was accordingly followed. Later on, an analysis of the water was reported, which showed a content of about 100 mg. of SO_3 per liter.

The hydraulic equipment was designed and built by the Pelton Water Wheel Co., of San Francisco.

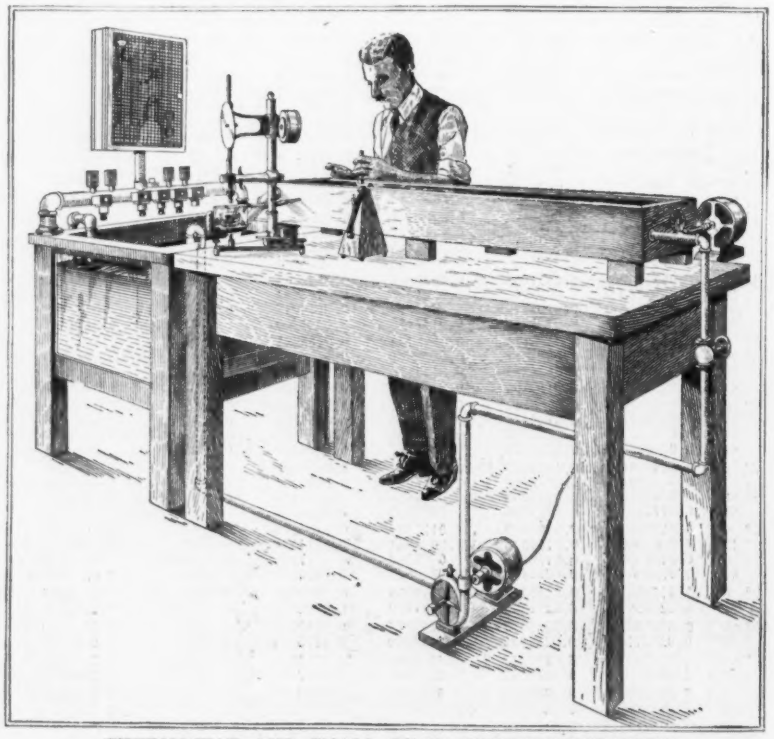
Motor-Driven Pump Circulates Constant-Temperature Water

ONE of the most troublesome details in making penetrations and ductility tests of asphalt is that of maintaining the water of immersion at exactly 25° C. Numerous experimenters having demonstrated the effect of even a few degrees departure from the standard temperature, much time is ordinarily spent on initially bringing the bath to the proper thermometer indications, but always with the certainty that it will not remain at this temperature unless the room happens to be at the same point. The trouble of continually adding cold or hot water is not only a distraction, but also extremely difficult of manipulation.

The illustration shows an arrangement of a ductility machine of the type developed in the Office of Public Roads, a New York State penetrometer and an Eimer & Amend water thermostat as used in the Municipal Testing Laboratory of the City of St. Louis, Edgar P. Withrow, engineer in charge, and the Standard Laboratory of New York City. Water is drawn from the thermostat by the centrifugal pump shown in the lower left-hand corner. The pump is driven by a ¼-hp. moter under speed control.

Forced by the pump, the water enters the ductility tank at the back end, near which point is located a valve by means of which the flow of water may be regulated so that its velocity will not interfere with the continuity of the test piece when it is drawn out to some length. The water flows then to the water bath of the penetrometer, the excess spilling into the thermostat —some of it having been bypassed directly to the water thermostat.

The water thermostat, being under very definite control, can be left running continually. Unless the room temperature is widely different from that of the temperature desired in the water baths, the heat lost or gained in the piping from the thermostat to the point of demand is slight. However, allowance for temperature loss or gain is easily made by an adjustment in the thermostat. Use has shown that this arrangement keeps the test baths at a practically constant temperature, not tolerating a variation of over 1° C. from entrance to exit.



THERMOSTAT AND SMALL PUMP KEEP WATER BATH AT CONSTANT TEMPERATURE

Gas Calorimeter Tables of the Bureau of Standards

THE numerous requests for a brief and concise set of operating directions for a gas calorimeter, and for a convenient set of correction tables, have resulted in the publication by the Bureau of Standards of a circular entitled "Gas Calorimeter Tables." This may be regarded as a supplement to Bureau Circular No. 48, "Standard Methods of Gas Testing." The correction tables are arranged in a sequence most convenient for use in connection with the proposed record sheet.

The record forms for calorimeter tests which are shown in the circular have been used for some time and have been found to be complete and convenient. It is hoped that these forms will be adopted wherever possible, so that there will be greater uniformity in operating methods and the records used. The bureau is willing to lend the original plates for preparation of electrotypes for these blanks to any one desiring to print them.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

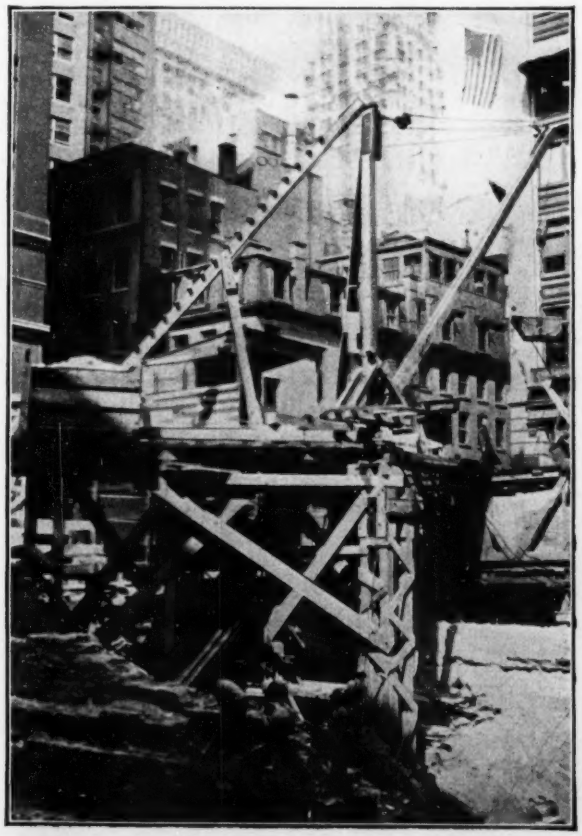
Sink Pits for Derrick Towers in Advance of Basement Excavation

By Frederick B. Spencer
Engineer in Charge, Smith, Hauser & MacIsaac, Inc., New York City

IN CONSTRUCTING the foundation for a 20-story building at William and John Sts., New York City, one derrick, which it was necessary to set up before excavation was begun and to continue using during and after the completion of the excavation, was set on timber towers placed in pits dug before the excavation was started.

The photograph below shows the towers uncovered part way to the bottom by the general excavation. The posts of these towers are 10 x 10's 40 ft. long, two under each deadman, four under the hoist and four under the mast. All were placed so as not to interfere with the foundation work. The derrick, which has a capacity of 10 tons, has been used entirely in handling dirt, dumping into a 50-yd. loading hopper over the street.

The work on the building mentioned is being carried out by Smith, Hauser & MacIsaac, Incorporated.



DERRICK SET ON TIMBER TOWERS

LINE OF SHOES, TRACK AND BLOCKING UNDER EACH GUNWALE

Move 1000-Ton Barge a Mile in 60 Days on High Blocking

A ONE-THOUSAND-TON barge that had been beached in a heavy gale was recently raised and moved one mile across rough ground and two swamps on two lines of rollers by a Seattle contractor. The barge, which grounded seven miles south of Copalis, Wash., on Mar. 20 last, was in use in hauling supplies for the Government railway in Alaska, by the Columbia Barge Co., of Seattle. It could not be pulled off or launched where it lay, because of the surf; hence, the necessity for moving it to a bay where it could be launched again in sheltered water.

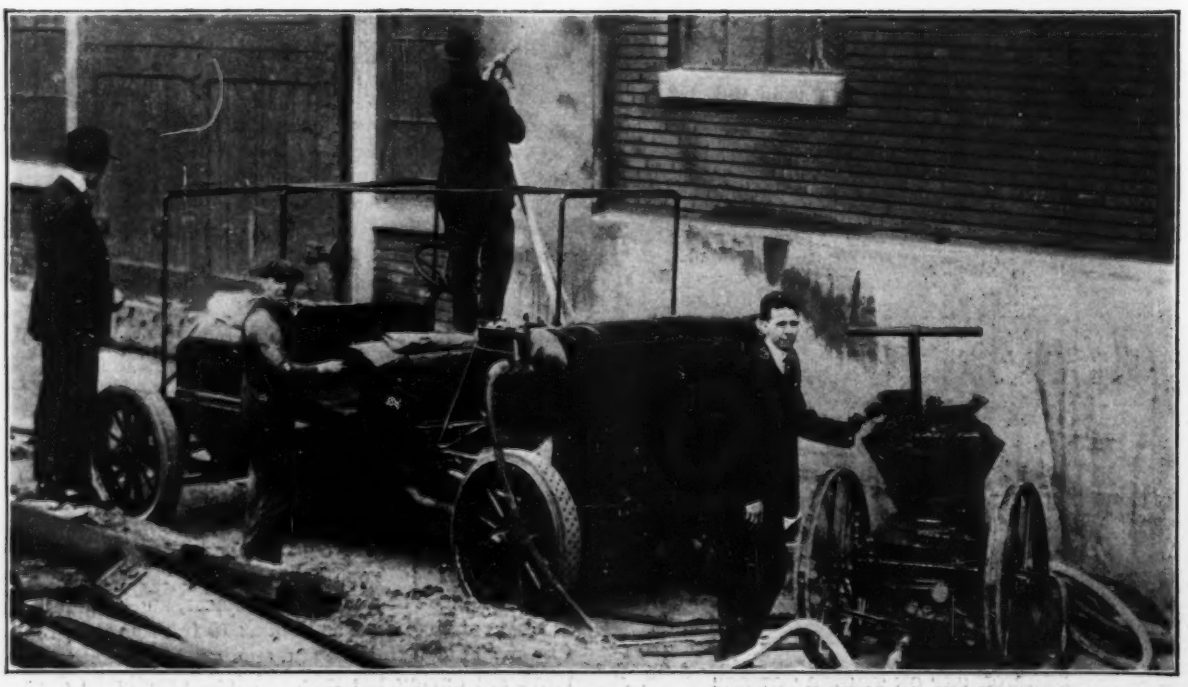
The work was begun by placing 200 jacks under the barge, which weighed 1000 tons, and raising it so that shoes, blockings and rollers could be placed under each gunwale. Twenty shoes carrying the barge on transverse timbers were used. The 8-in. oak rollers under the shoes rolled on 10 x 12-in. track timbers, resting on a line of cribbing under each side of the barge. The barge was pulled straight ahead, turned toward the bay after it had traveled two or three lengths, and carried straight across the peninsula. Power for pulling was furnished by the donkey aboard the barge, about 2000 ft. of 1½-in. rope being used in the tackle. Cuts had to be made at a number of places, and at others the blocking at times was as high as 10 ft. from the ground. One swamp 500 ft. wide and another 200 ft. across were traversed during the trip. It took exactly 60 days to

MANY CUTS FOR THE TRACK TIMBER HAD TO BE MADE—AT POINTS CRIBBING 10 FEET HIGH WAS USED

move the barge and launch it in the bay on the opposite side of the peninsula. The work was done by Curtis Brothers, of Seattle.

Turn Touring Car Into Traveling Compressor for Cement Gun

THE photograph below shows a pleasure car converted into a portable compressor unit and used by the Reid-Waples Co., of Philadelphia, for operating a cement gun. The unit, which is said by this contracting company to be the most efficient portable compressor that it has ever had, consists of a Pierce-Arrow chassis with the original six-cylinder motor, the original transmission and a two-cylinder air compressor. It was built under the supervision of the company's men after searching the market for a portable compressor unit suitable to its business. The original clutch is retained, which allows the motor to run free from the compressor. When air is desired, the clutch pedal is thrown out and the original gear shift brought into play, which permits using three speeds of the engine in compressing air and increases the efficiency of the unit according to the demands made by the extent and character of the work under way.



COMPRESSOR DRIVEN BY AUTOMOBILE ENGINE STATED TO BE MOST EFFICIENT PORTABLE AIR UNIT

Dumping Trestle on Rollers Keeps Teams Hauling Tunnel Spoil on Move

BY MOUNTING a dumping trestle, 160 ft. long, on house rollers, teams hauling spoil from the shafts of a sewer tunnel lose no time at the dump end of the trip. The work is at Evanston, Ill., for the Sanitary District of Chicago. Up to 300 loads are hauled in a night of 16 hours, with an average of 200 loads. Much of the spoil, used as fill along the lake front, is of slippery clay, miry when wet, but the trestle rests on leveled material after it has settled, paralleling the shore line.

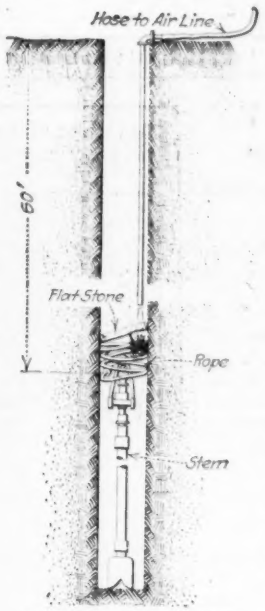
The trestle consist of two inclines, 75 and 60 ft. long for the upgrade and downgrade respectively, and a 25-ft. level section 9½ ft. above the ground surface. It is made up of 5-ft. bents with all members (hard maple) bolted together so that the 14,500 ft. of timber may be salvaged. The lower chord is an 8 x 12-in. timber, and the uprights are 4 x 6 in., suitably braced. The dump wagons discharge through a trap above a metal-lined chute at right angles to the trestle.

This chute is lubricated evenly by water from a perforated 1¼-in. pipe. A hose was used at first, but did not furnish enough water or an even supply. When the material has piled up against the chute, two men in 10 min. move it 10 ft. forward (along the shore) by means of a winch and four-part tackle with cable attached to a deadman.

Along the lake side for 30 ft. down each incline and for the level portion, a blind of 1-in. boards 5 ft. high was built so that the horses would not become frightened in the event that spray from high seas reached the structure.

Tony Ziegenfelder, superintendent for George W. Jackson, in charge of the work for the Nash-Dowdle Co., built the trestle in five days with the aid of four carpenters and one laborer.

Get at Lost Drill 60 Feet Down by Burning Rope Out of the Way

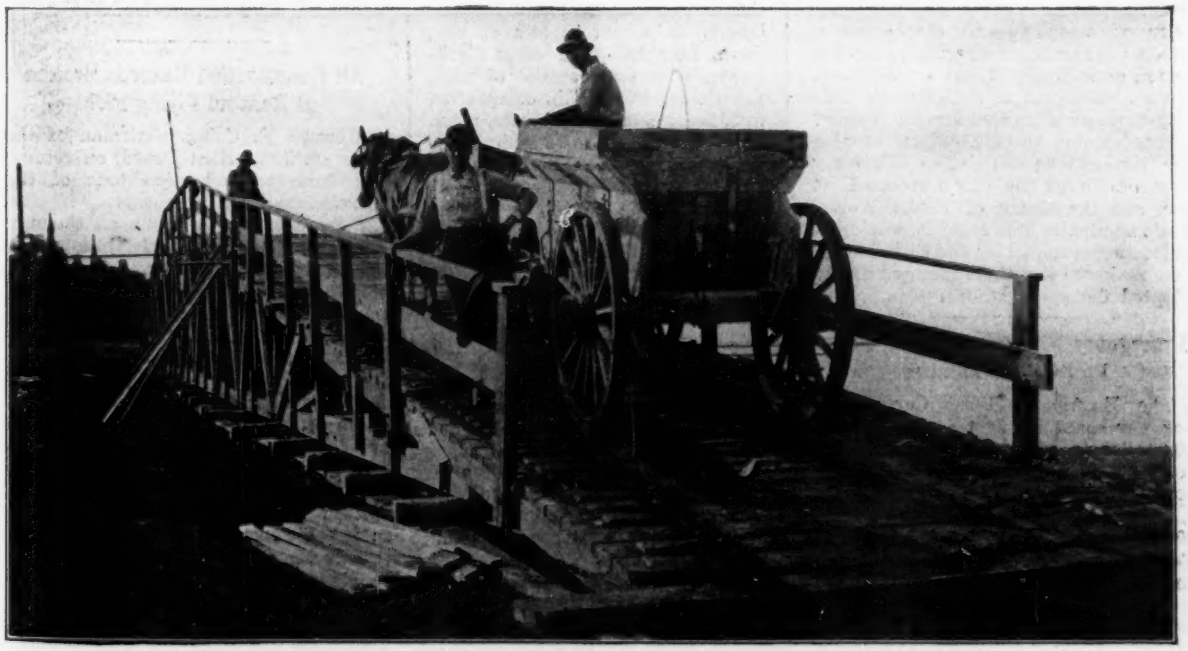


BURNING OFF ROPE FROM LOST DRILL BIT

A NOVEL method of recovering a lost drill stem is reported by H. S. Carpenter, of Billmyer, Penn. During operation the drill rope broke when the stem was about 60 ft. down, and a loose flat stone apparently fell right on top of the coiled rope and prevented reaching it with a spear in the usual manner. Kerosene was then poured into the hole, and a piece of ½-in. pipe, attached to the air line, was lowered over the rope as shown in the sketch. A piece of waste was then ignited, dropped down the hole and the air turned on. The accelerated flame soon burned off the rope, and the stone slipped down beside the stem, permitting the easy recovery of the bit with the usual fishing tools.

Autos and Motor Trucks Outnumber Horses

The daily travel on the 14 roads leading into Milwaukee has been counted, from April to November, and the results show that the automobile has supplanted horses on all but two of these thoroughfares. Taking all the roads together, the average daily travel comprised 7372 automobiles, 740 motor trucks and 4334 teams, a total of 12,446 vehicles.



WAGONS DUMP INTO SLUICEWAY AT RIGHT ANGLES TO TRESTLE

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Los Angeles Will Permit Use of Concrete Sewer Pipe

Outcome of Protracted Struggle Between Vitrified Clay and Cement Interests

EDITORIAL CORRESPONDENCE

The Council of the City of Los Angeles, Calif., has just adopted specifications for the construction of sanitary sewers within the city which permit the use of concrete sewer pipe. The specifications require the pipe to be mechanically tamped and fed, the aggregates to be carefully selected and graded, and proportioned one part of cement to three of aggregates. The tests require 15 lb. hydrostatic pressure held for 5 min. without percolation, a 30-lb. fracture test and a 5% absorption test. These tests are similar to but more severe than those recommended this year by Committee "C4" of the American Society for Testing Materials. There are no provisions in the specifications for hydrostatic or absorption tests for the vitrified pipe.

The adoption of these specifications is the outcome of a protracted controversy between the vitrified clay products interests in the city and the manufacturers of cement pipe. The Board of Public Works adopted these specifications over a year ago and they were transmitted to the city engineer for his approval. The Board of Public Works held public hearings at which testimony was received as to the quality and durability of cement pipe for use in sewers. The matter dragged on with no definite action until finally it was brought to a climax by appeal to the Council. The city engineer submitted a report strongly condemning the use of cement pipe for sewer purposes. The Efficiency Commission of the city advocated its use, and the Board of Public Works, while nominally approving it, was more or less noncommittal. The City Council then reviewed the whole case and finally adopted the specifications.

Emergency Fleet Corporation Buys First Lot of Lumber

The Emergency Fleet Corporation has purchased its first installment of 10,000,000 ft. of lumber under its contract with the Coos Bay Lumber Company.

This contract provided for the sale of 30 units of fir timber for vessels of the Ferris type, the lumber to be delivered on the dock at Marshfield, Ore., for $30 per thousand. There was a 40-mile rail haul behind the final delivery of the lumber.

To Command Tenth Reserve Engineer Regiment

LIEUT. COL. JAMES A. WOODRUFF

THE "forest regiment," designated the Tenth Reserve Engineers by the War Department, will convert available timber behind the battle lines in France into the railroad ties, trench timbers, mine props, bridge timbers, lumber and cordwood needed in the military operations of the British army. The work may, it is stated, fall within the danger zone and will be done largely in sprout forests of oak, beech, hornbeam and other hardwoods, with some stands of pine. The timber is small in comparison with most American forests, much of it being from 8 to 12 in. in diameter. These forests resemble the woodlots of southern New England, and the operations will be similar to portable sawmill logging and tie cutting in Massachusetts, Connecticut, Maryland and Virginia.

Railroad Will Begin $500,000 Water Terminal at Mobile

A $500,000 first unit for a water terminal for the Gulf, Mobile & Northern R.R. at Mobile, Ala., will be started soon. The unit will consist of a pier and slip large enough for several ships, and a series of warehouses. In all, there is to be 4000 lin.ft. of berthing space and 2000 lin.ft. of warehouses, some of which will be five or six stories high. Another unit to double the capacity of the terminal and also 2000 lin.ft. of lumber docks are contemplated.

United Engineering Council To Aid Government

Joint Committee Appointed from Civil, Mining, Mechanical and Electrical Groups

To aid the Government to get engineers and to utilize to the fullest the ability of its members, the United Engineering Society has appointed a council of twenty-four engineers. The society, which includes the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, made this announcement June 29. The personnel of the council is:

Civil—J. F. Stevens, George F. Swain, F. H. Newell, Alexander C. Humphreys, F. D. Galloway.

Mining—S. J. Jennings, B. B. Lawrence, J. Park Channing, Edwin Ludlow.

Mechanical—I. N. Hollis, Charles Whiting Baker, John H. Barr, A. M. Greene, Jr., D. S. Jacobus.

Electrical—H. W. Buck, E. W. Rice, N. A. Carle, P. Junkersfeld, C. E. Skinner.

United Society—Clemens Herschel, B. B. Thayer, I. E. Moultrop, Calvert Townley.

The Government was notified of the creation of the committee, and H. W. Buck, A. M. Greene, Jr., and Edmund B. Kirky were appointed to find the best method of coöperation.

All Construction Records Broken at Rantoul Flying Field

Howard E. Coffin, chairman of the Aircraft Production Board, on returning from an inspection tour of the aviation training fields, said:

"The construction work on Chanute Field at Rantoul, Illinois, has broken all records. A half-million dollars' worth of buildings have been put up practically within a month. They form a village a mile long, and the speed with which they have virtually sprung out of the ground has been deeply impressive. A few weeks ago the big mile-square space was simply a collection of cornfields.

"The explanation for the speed with which the work has been done is the spirit which has filled the men engaged in it. Union men and nonunion men are working side by side in the effort to advance the national interest. There are 2000 men on the job, and there has not been a disagreement or row of any kind since it started."

Building Restrictions for Portland Under Study

Code with Use and Height Limitations Being Considered by Council and Engineers

EDITORIAL CORRESPONDENCE

The City Council of Portland is holding a series of public hearings upon a new building code, which has been prepared by the committee appointed by the Council some two years ago. This suggested code is very complete and explicit in its provisions, and while it has aroused some opposition from realty and material interests, the general opinion among local architects and engineers is that it should be adopted with very few alterations.

Coincident with the completion of this code there is a renewal of interest in the subject of city zoning and the limitation of building heights and occupancy. On the evening of June 28, the Oregon Society of Engineers held a meeting which was addressed by a number of architects and others. The reports of New York and other city commissions who have reported on the subject were reviewed. It was pointed out that Portland was particularly in need of measures limiting heights of buildings, on account of local conditions, the narrow streets and the prevalence of cloudy weather.

Some four years ago Portland received the report of a city-planning committee. This committee had prepared plans and drawings of an elaborately ideal city arrangement with civic and industrial centers, parkways and boulevards. The plan involved an excessive expenditure, and there have been only scattering attempts to carry out any of its features. In contrast the present proposed zoning of the city is very practical. The limitation of building heights has been a success elsewhere, and aside from those adversely affected receives little opposition. The limitation of occupancy and restriction of certain industries to definite zones has been adjudicated in other places, notably Los Angeles, where a Supreme Court decision made restriction of occupancy permissible under the police powers inherent in the city government.

Friendly Suit Clears Oregon Road Bond Question

In an opinion written by Justice Moore, the Supreme Court of Oregon held that the Board of Control is legally authorized to issue bonds under the Bean-Barrett law, to match Federal appropriations for highway construction, and issued a writ of mandamus commanding it to issue the bonds, totaling $491,967.11, to match a like sum now available from the Government.

The decision was the result of a friendly mandamus proceeding instituted by the State Highway Commission against the Board of Control, to compel the latter to issue bonds.

Stops Ship Building Information

As a war measure, the Government has found it necessary to adopt the policy of discouraging, in every reasonable way, the publication and dissemination of information in regard to merchant-marine ship construction that might aid or influence the military plans of the enemy, in the present emergency.

To conform to this policy, the United States Shipping Board Emergency Fleet Corporation hereafter will not be able to give out for publication, or other use, any information relating to the number, size and character of vessels under contract, the place where they are being built and by whom, and the percentage of completion, date of final completion, etc.

Mississippi River Dam at St. Paul Is Formally Opened

The St. Paul-Minneapolis lock, Mississippi River Dam No. 1, was formally opened July 3 by the passage of the Government boat "Dandelion" through the lock with a party of officials and citizens of the two cities, guests of Col. Edward H. Schulz, United States Engineers, under whom the project was completed. The lock has a lift of 30 ft. and, until such time as additional operating machinery is installed, the lock will be operated between 8 a.m. and 4 p.m. for boats not exceeding 36-ft. beam, although the lock is designed for boats of 78-ft. beam.

Municipal Improvements Convention Postponed for War Reasons

At the last meeting of the executive committee of the American Society for Municipal Improvements, it was decided to postpone for perhaps a year the convention which had been scheduled for Nov. 12 to 16, this year, in New Orleans. So many of the members of the society have enlisted in the army that it was felt that not only would the attendance be small, but that the unusual burdens which those remaining at their work would have to carry would make a good attendance at the convention extremely improbable.

Offer Business Men Assistance in Choosing Technical Advisers

Having made a success of the service clearing-house department, which is of help to the engineer primarily, the American Association of Engineers now proposes to establish a similar service to furnish business men with information concerning consulting engineers. A register, free to the public, is to be maintained of civil, electrical, mechanical, paving, sanitary, chemical, appraisal, public-utility, ceramic and irrigation engineers.

National Guard Cantonments Soon Under Way

Tented Cities as Carefully Considered as More Permanent Camps—All But Two Are Located

Steps are now being taken to build 16 cities of tents to receive the National Guardsmen who will be called to the colors soon. It will not take so long to make them ready for the troops, and for this reason the work on them has been held back until the wooden cities were planned and put under contract. The location of two of them has not yet been fixed, but it is expected that a decision will be reached in a few days. The sites already determined are: Fort Worth, Tex.; Fort Sill, Okla.; Deming, N. M.; Waco, Tex.; Houston, Tex.; Linda Vista, Calif.; Greenville, S. C.; Augusta, Ga.; Macon, Ga.; Montgomery, Ala.; Anniston, Ala.; Fayetteville, N. C.; Palo Alto, Calif., and Spartanburg, S. C.

SIMILAR TO WOODEN CAMPS

These camps will be laid out to accommodate approximately 35,000 men in each, and possibly as many as 10,000 horses and mules. They will be built by the same methods that are followed in the case of the wooden camps and under the direction of the same officer, Col. I. W. Littell, of the Quartermaster Corps, who must construct the water and sewerage works and erect wooden kitchens, mess halls, hospitals, storehouses and many other structures for which tents are undesirable. Fortunately, the task will be somewhat simplified by the fact that the designs prepared for the National Army camps can be used for the National Guard camps.

A number of the leading specialists of the country have been coöperating in the general plans for the sanitary and water-supply features, which will be in every respect the equal of those for the National Army cantonments.

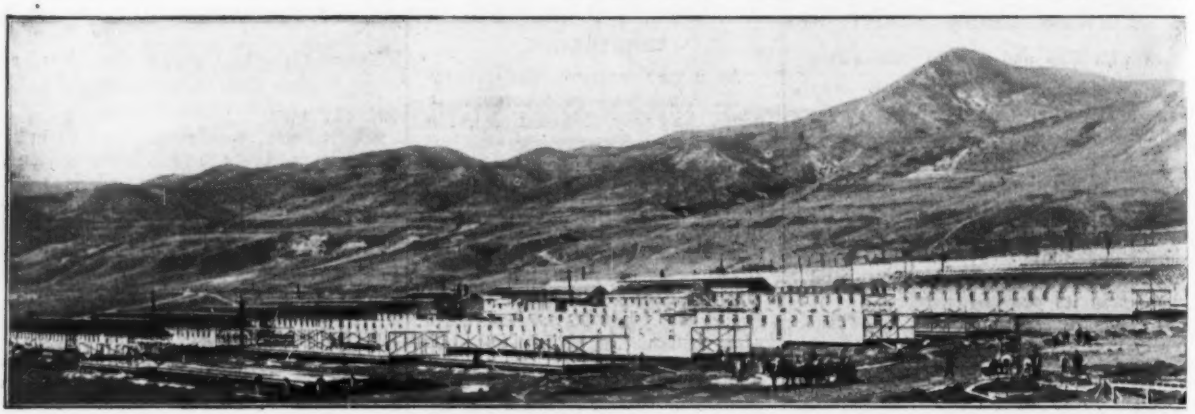
Littell Explains Method of Paying Cantonment Contractors

Col. I. W. Littell, Quartermaster Corps, who is in charge of cantonment construction, in a letter sent to the General Munitions Board in reply to reported delays between the forwarding of invoices for materials shipped on Government order and the date of payment therefor, states:

"It is the intention of the cantonment division to pay contractors for the National Army cantonments daily, covering material inspected and accepted and to which the United States takes title; weekly, for the purpose of their payrolls; and monthly, on the ninth of the month, for all other bills not settled for in the daily payments.

"Under this very liberal provision it is not understood how there can be much delay in payments or that it will necessitate contractors on this work securing financial assistance due to delay in payment."

FORT DOUGLAS—FIRST REGULAR ARMY CANTONMENT TO



ACCEPTED BY THE GOVERNMENT JUNE 26, HAVING BEEN MADE

Commissions Signed for Officers of First Illinois Engineers

Engineers heading the First Regiment, Illinois Engineers, National Guard, have been informed that commissions as follows have been signed:

Colonel, Henry A. Allen; lieutenant colonel, Gordon Strong; captains, Walter Henry Allen, B. C. Allen, Dwight Guilfoil, Jay A. Rossiter, Walter Roth; senior first lieutenants, Ralph C. Harris, John J. O'Connor, Al H. Sheffield, John K. Thompson; junior first lieutenants, F. H. Cobb, H. L. Laughlin, L. J. Hughes, Harry L. Hudson; second lieutenants, John H. Jacobsen, D. A. Tomlinson, C. A. Waterhouse, Walter H. Wood.

Chattanooga Soon To Have Electro-Metallurgical Plant

Actual manufacture of ferro-alloys will probably begin in October at the old plant of the Southern Steel Works in Chattanooga, which has been taken over by the Southern Ferro-Alloy Co. Hydro-electric power will be obtained from the Tennessee Power Co., 3000 hp. having been contracted for. The first product of the new company will probably be ferro-silicon, 50% or higher. The plant of the old steel company is fairly well adapted to the new purpose, but three months will be necessary for its remodeling and for the installation of machinery, which was designed by the Fitz-Gerald Laboratories, of Niagara Falls, New York.

Give Summer Course in Concrete at University of Chicago

Although the University of Chicago gives no engineering courses, it has seen fit to put on a course of lectures on concrete, open without charge to all interested. They are given by engineers and teachers familiar with the industry. Some of the subjects are as follows: Materials, proportioning, molds, reinforcing principles, calculations, surfaces and curing. The course ends July 23.

Stevens Reports on Railroads to Russian Government

M. Stephanoff, temporary Minister of Trade and Industry of the new Russian republic, on July 4 received John F. Stevens and the other members of the American Railroad Commission. The commission later issued a report of the result of its inspection of the Russian railroads, together with recommendations for reforms. It declares that the commission considers that Russian railroads have an excellent technical personnel, and that many roads have a good practical system of management. The first necessary reform affects the traffic system and involves the employment of more powerful locomotives and of freight cars of larger carrying capacity.

Workshops Must Be Built

The construction of workshops at Vladivostok for the putting together of locomotives imported from the United States is necessary and in all repair shops work must continue uninterruptedly 24 hours a day, thus enabling a reduction in the percentage of locomotives out of use.

Chairman Stevens sent a cablegram to Washington, requesting that the construction of locomotives and cars be undertaken at once. The order, it is said, will require the increase of America's credit to Russia by $375,000,000. In giving this order the commission was guided by the desire to afford Russia all possible support in the common cause. The commission is still engaged in considering the question of the supply of raw material, rails and machinery for the Russian roads.

Form Russian Society of Engineers

A Russian Society of Engineers has been formed in Chicago to furnish information to the many engineers going to Russia at the present time and to assist in picking out engineers who are to be sent there to aid in handling the many problems of the war.

Aviation Activities at Dayton

The new 3300-acre aviation field at Dayton is near the old Wright brothers camp, where so many Canadian flyers were trained. H. C. Wright, city water superintendent, is putting in two 400-gal.-per-min. triplex well pumps in stations 3500 ft. apart, connected by 5 miles of 6- and 8-in. cast-iron pipe. Over a mile of pipe has been laid, at a cost to date of less than 7c. per ft. An Austin trencher and eight men constitute the crew. The camp will have 24 hangars, each to house eight airplanes, and the accompanying barracks, shops, steam-heating plants, etc. It is expected that 1,000,000 yd. of earth will have been moved in the grading operations by Sept. 1. A gravel pit for concrete for the hangar floors has been opened in a standing wheatfield. Capt. C. J. Warring is the officer in charge, and S. S. King, of Dayton, is the contractor.

Engineers' Club Building Under Way

Other activities in Dayton, which a representative of *Engineering News-Record* found in a day's tour of the city, are as follows: The brick walls of the new engineers' club building are rising rapidly. In Dayton View, Durax paving is being laid on a 7% grade, and downtown on Third St. 20,000 yd. will soon be down. City Manager Waite says the street intersections paved two years ago, when the American Society of Municipal Improvements met in Dayton, have shown no appreciable wear. The city expects to do as much paving as in former years, but is finding some difficulty in getting bids. The low municipal dam, to make slack water for a city recreation park, was submerged in a recent mild flood, but is about half completed.

Water-works extensions for 1917, as outlined in a report made by Leonard Metcalf in April, include a 10,000,000-gal. centrifugal emergency pump at Tate's Hill, which has not yet been ordered, and 1500 tons of cast-iron mains already contracted for. The Domestic Engineering Co. has turned over its newly completed factory buildings.

BE COMPLETED IS PROTOTYPE OF NATIONAL ARMY CITIES

READY FOR OCCUPANCY 26 DAYS AFTER THE CONTRACT WAS LET

Commission To Purchase Material for Rebuilding France

The French *Journal Officiel* has published an order of the Minister of the Interior, constituting a committee of 15 members, to be known as the "Commission Consultative des Marchés et des Stocks," the duty of which will be to study administrative and technical questions in reference to contracts for purchasing stocks of provisional houses and materials for provisional and final reconstruction work in invaded districts of France. The committee will also take charge of and oversee stocks of houses and material furnished. Monsieur Ogier, Conseiller d'Etat, Directeur du Contrôle et de la Comptabilité, Ministère de l'Intérieur, Paris, has been named president of the committee.

California Commission To Consider Los Angeles Union Terminal

A union passenger and freight railroad terminal in Los Angeles will be considered by the California Railroad Commission on July 24. The Supreme Court of the state recently gave the commission undisputed jurisdiction over railroad crossings, both within and without incorporated municipalities. This jurisdiction had been opposed by the Los Angeles city attorney, who claimed that while the commission had complete authority over union terminals in Los Angeles it did not have control of grade crossings within that city.

The decision has eliminated the opposition, and the commission has promptly laid plans for complete investigation of the demands which are being made for the consolidation of Los Angeles railroad terminals. The case carries with it both freight and passenger service, includes all steam roads entering Los Angeles, and the question of how crossings shall be protected throughout the city. The commission is asked to require the railroad companies to build a union terminal and to reconstruct their tracks running to and from the terminal so as to eliminate grade crossings, which are the cause of death and injury.

Must Reinstate Boston Engineers Decapitated in 1916

The full bench of the Supreme Court of Massachusetts has upheld the lower court in declaring that the attempt made on Jan. 22, 1916, to abolish a number of offices in the Public Works Department of Boston was an evasion of the law and that the men must be reinstated. The decision was rendered on an appeal by Edward F. Murphy, commissioner of public works of Boston, against the order of the lower court for the reinstatement of Frank A. McInness, division engineer of sewer and water service; Bliss W. Robinson, superintendent of main drainage, and Storrs L. Durkee, supervisor of permits. These and 14 other men in the same department were decapitated under the guise of abolishing various offices. The three men named brought action for reinstatement. They were backed by a number of the leading engineers of Boston, including F. P. Stearns. The decision just rendered deals almost wholly with various technical points. It concludes as follows: "Because the findings of fact are conclusive and final, no question of law is before us and the exceptions must be overruled."

The names, positions and salaries of the 17 decapitated men were published in *Engineering News* of Jan. 27, 1916, page 291, and editorial comment appeared on page 193 of the same issue.

Navy Camp Contracts Let

The Bureau of Yards and Docks, Navy Department, on July 3 awarded contracts for construction work on the training camp at the Hampton Roads naval base, as follows:

John B. Wilson, Richmond, Va., and Carolina Wood Products Co., Asheville, N. C., camp for 5000 men, each contractor to build half of the camp; Richardson Co., Norfolk, Va., reconstruction of buildings now on properties; Newport Engineering and Contracting Co., Newport News, Va., building of the hospital.

Dallas Has Good Construction Program Under Way

Actual and contemplated construction in Dallas, Tex., includes several large undertakings. After long negotiations with the Texas & Pacific Ry., tracks on one of the principal downtown streets will shortly be removed and a large industrial district created. The Missouri, Kansas & Texas Ry. grade-elimination work is nearing realization.

In the building line the foundations for the $1,000,000 structure for the American Exchange National Bank are under way. Eight stories are being added to the Chamber of Commerce Building. Butler Brothers are doubling their capacity and the work will shortly be completed. The Adolphus Hotel is adding a 12-story annex, and the Morten Investment Co. is erecting a 10-story hotel near the recently completed Union Terminal Station.

Shortly $2,000,000 will be spent on the Dallas Street Railway and Light Co., and one interurban will be built, either from Dallas to Terrell or to Greenville.

Assessment for Street Paving Need Not Be Uniform

The Minnesota Supreme Court has upheld the city in its plan of assessment for Marshall Ave., Minneapolis, paving. A portion of the street has a street-car line on it, and the company paved the part of the street occupied by its tracks. The property owners along the car line were assessed $5.50 a front foot and, where there was no car line, $8.20 a front foot for creosoted wood block, all put in under one order. The property owners paying the higher rate brought suit, maintaining that the assessment should be uniform along the entire length of the street. Quoting from the decision: "Street-car tracks and the operation of cars circumscribe the use of the street. The situation is much the same in principle as it would be if one portion of the street between curbs were wider than another." The street railway company paved its part of the street.

Chicago Street and Sewer Construction Is Normal

Report Indicates Usual Amount of Municipal Improvements Is Under Way

Contractors on municipal work in Chicago have taken at least the usual amount of work. Thirty-two sewer contracts aggregating $79,000 have been let for prices about 20% higher than two years ago, but the work is going ahead. Forty-four more, involving $203,000, are ready to let. This is the beginning. It is normal in amount; last year totaled 200 jobs and $1,600,000. Normally the Board of Local Improvements allows 20% for profit and discounting of paper. At present the engineers are adding approximately 10% additional

LET CONTRACTS BY SPECIAL EXPEDIENTS

They are not finding it easy to let contracts and are using several expedients. For instance, contracts are being grouped in districts and by classes of excavation encountered, such as sand, rock, clay and machine work, so that the contractor will save moving expense. For the next letting fourteen smaller jobs have been so grouped. Then designs are being amended carefully to eliminate anything not absolutely necessary. The labor situation is not so serious as it might be. Trenchmen are being recruited from the ranks of the hod carriers, cellar excavators, etc., the excavators' unions controlling all of these men and permitting the switch to the conduit work.

The most reassuring fact is that new work is being planned as usual. Last week a $535,000 system known as the Augusta Street system, was put into Council and should come to the contract stage by fall or early next spring. The $500,000 Crawford Avenue sewer may be out of the courts with good luck and ready for letting within a month. Surveys are going ahead on the widening of Ogden Avenue, a proposed diagonal 90-ft. driveway from the North to the West Side, 2 miles long, through built-up territory, from Lincoln Park to Randolph Street. The immense double-deck boulevard link project over the river, so long held up in the courts, is expected to be out within 60 days. The engineers are confident contracts on foundations can be let by early fall.

City bridge work is progressing satisfactorily. At Wells St. and Franklin-Orleans, the contractors are assembling material on the ground.

Small water-pipe extensions will be curtailed on account of the cessation of small building. It will probably reach 70 miles however. This pipe is laid by day labor and the pipe, 10,000 tons of small and 5000 of large, was purchased last year at $35. The department expects this supply to be sufficient for the season and little of the larger sizes will be laid.

No diminution is expected in the regular $5,000,000 to $6,000,000 paving schedule. Nearly 200 contracts have already been let at eight lettings aggregating $3,300,000 and work on the 55 miles of "left over" from last season is being pushed.

The contracts for 19 miles of asphaltic concrete on a concrete base on Higgins Road in Cook County will probably be executed with the Commonwealth Improvement Co. by the time this is printed. The company has placed a subcontract for Koppel equipment for 8½ miles of narrow-gage railroad and necessary dump cars for handling aggregate.

The Illinois Central Railroad Co. last week called for bids on the reconstruction of eight grade crossings in Hyde Park, aggregating about $500,000. Work by Bates & Rogers on five in Woodlawn is 80% done. Bids were asked of Chicago contractors last week on a dam in Franklin County by the U. S. Fuel Co., subsidiary of the U. S. Steel Corporation.

Work is progressing at full pressure on the Pennsylvania freight station, two Montgomery-Ward buildings, the Field Museum, several skyscrapers in the Loop, additions to the Inland Steel Co. plant, and the huge new development by the Mark Manufacturing Co. at Indiana Harbor, in addition to numerous smaller industrial plants in the city and lake towns to the south.

Pacific Coast Fuel-Oil Situation Becomes Critical

At a hearing before the California Railroad Commission in San Francisco, W. R. Scott, general manager of the Southern Pacific R.R., stated that trains would have to be discontinued on the Southern Pacific lines within 30 to 90 days unless the oil situation is speedily relieved. The railroad company is applying for a 15% increase in interstate freight rates, and in connection with the increased price of oil from 70c. last year to $1.50 at present, it was brought out that the Southern Pacific R.R. consumes about 44,000 bbl. per day. Of this amount about 26,000 bbl. are furnished by the Kern Trading and Oil Co., a subsidiary corporation, and the remainder has to be purchased in the open market.

FAIL TO LOCATE COAL SUPPLY

Mr. Scott said that the Southern Pacific had endeavored to meet the oil shortage by searching for coal supplies, with the idea of converting one or more divisions from oil to coal, but that the company had failed to locate any coal supply sufficient to warrant consideration on this basis.

With regard to the reserve supply of oil held by the company, Mr. Scott said: "Ninety days is the maximum time which the Southern Pacific can continue to handle its business under present conditions. At the rate we are drawing on the oil storage at present, it will be exhausted in 60 days unless we can buy more than heretofore in the open market."

ENGINEERING SOCIETIES

The Engineers Club of Seattle was addressed by R. M. Dyer, president of the Pacific Northwest Society of Engineers, on June 28. The subject of Mr. Dyer's talk was "Wooden-Ship Construction."

The Oregon Society of Engineers, Portland, Ore., discussed the enactment of "zoning ordinances" at a recent meeting.

The Albany Society of Civil Engineers held its annual outing Saturday afternoon, July 7, inspecting the plant of the Rensselaer Quarry Co., at Brainard, New York.

The Engineers Club of San Francisco was addressed by Lieut. J. B. Howell, U. S. N., retired, on "Submarines" at its weekly luncheon talk, June 21.

The Connecticut Society of Civil Engineers will meet at Charter Oak Hall, New Haven, Conn., co-jointly with the local members of the American Society of Civil Engineers. Charles A. Ellis, professor of structural engineering at the University of Illinois, will deliver an illustrated talk on the Quebec Bridge.

PERSONAL NOTES

S. U. HOOPER has been appointed assistant superintendent of the Toledo division of the Cincinnati, Hamilton & Dayton Ry., with headquarters at Toledo, Ohio, succeeding E. W. HOFFMAN, promoted.

JOHN MEEHAN, Burlington, Wash., has been appointed engineer of that city.

GEORGE GERHARD has been appointed city engineer of Anacortes, Washington.

LEE F. DILLON has received a leave of absence from his position as inspector in the bridge department of the Illinois Central Railway Co. and has been certified for a commission as second lieutenant in the Engineer Reserve Corps, now stationed at Fort Leavenworth, Kansas.

ROBERT F. OLDS has resigned from his position with the Austin Co., Philadelphia, and is now superintendent of construction, United States Engineer Corps, in the Wilmington, Del., office.

S. G. SWIGART, consulting civil and hydraulic engineer, has reopened an office in Akron, Ohio, having closed his office in Missoula, Mont. Mr. Swigart was connected with railroad and municipal work in Ohio and California in 1890. As consulting engineer in

Akron, Ohio, he located and built several of the early suburban electric railroads in that vicinity. From 1897 to 1901 he was in private practice in Cleveland, Ohio, mainly on suburban and interurban railroad location and construction, sewage construction and sewage-disposal works. In 1907 Mr. Swigart engaged in consulting practice at Fort Collins, Colo., during which time he designed and supervised the construction of several irrigation projects, including the Halligan dam, and from 1912 to 1916 he was irrigation manager of the Flathead project, United States Reclamation Service, with headquarters at St. Ignatius, Montana.

RAYMOND MATTHEW, for the past six months assistant engineer in the office of CHARLES H. LEE, consulting engineer, Los Angeles, Calif., has accepted the position of assistant engineer with the Idaho Irrigation Co., Richfield, Idaho.

E. S. BORGQUIST, who for the past two years has been with the United States Reclamation Service on the Strawberry Dam project, and who for the four years before that was with the Utah State Engineering Department, has been appointed water commissioner by the United States court to have jurisdiction over the irrigation system of the Lake Fork and Umpah Rivers in the Umpah Basin district. The district comprises an area of 100,000 acres of irrigated land, and its affairs are now in court, the United States Indian Service being the plaintiff.

FARLEY GANNETT, of Gannett, Seelye & Fleming, consulting engineers, Harrisburg, Penn., has been appointed an arbitrator to set the value of the Huntingdon Water Supply Co. plant and property. This company supplies the City of Huntingdon, Penn., and the value of the property is to be set by a board of five, at least two of whom must be engineers, for the purpose of determining the price at which the municipality shall purchase the property. THEODORE E. SEELYE, one of Mr. Gannett's partners, was on June 13 commissioned a captain of engineers, United States Army Reserve Corps.

SAMUEL LINDSEY NICHOLSON, who has been sales manager of the Westinghouse Electric and Manufacturing Co. since 1909, has been promoted to the position of assistant to the vice president, with headquarters at East Pittsburgh, Pennsylvania.

ARTHUR B. MCGEE has resigned as instructor in mathematics and surveying at Throop College of Technology, Pasadena, Calif., to take a position in the division engineer's office, Pittsburgh division, Pennsylvania Railroad Co., with headquarters at Pittsburgh.

CHARLES CARROLL BROWN has severed his editorial and business connection with *Municipal Engineering*. Mr. Brown began writing for the Question Department of that journal and also occasional articles in 1896, extending his work until in 1901 he took charge of the editorial department. Having acquired an interest in the company, he became vice president and treasurer of the Engineering Publishing Co., successor to the Municipal Engineering Co. For a time Mr. Brown was general manager of the new company.

E. W. SAWYER is now engaged in general contracting at No. 3 Gerard Road, Harrow, London, England, devoting his time to the design and manufacture of various war equipment for the allied governments. Mr. Sawyer gained much of his experience on Western American railroads and was for some time construction engineer for the Federal Telegraph Co., of San Francisco, and in that connection constructed several important radio stations on the Pacific Coast. He was in charge of the Canadian interests of the Universal Radio Syndicate, Ltd., of London, in 1913, and at that time built the transatlantic radio station at Newcastle, N. B., remaining as manager of that property until his departure for London in 1916.

WALTER W. MARR has been reappointed chief highway engineer of the Illinois State Highway Department as reorganized under the new civil administrative code.

FRED J. POSTEL, consulting engineer, of Chicago, has been appointed supervising engineer in the new Illinois State Department of Public Works.

WALTER A. SHAW, the engineer member of the Illinois State Public Utilities Commission, retains his position under the reorganization of the civil administrative code, which went into effect July 1. The salaries of the members have been reduced from $10,000 to $7000 per year.

RUDOLPH W. VAN NORDEN, consulting engineer specializing in hydro-electric power-plant design, has removed his offices to the Alaska Commercial Building, San Francisco, California.

THE L. B. STILLWELL ENGINEERING CORPORATION has been recently organized to design and construct steam and hydro-electric, electric, lighting, railway and power plants; electric transmission, electrification of railroads, steel rolling stock, railroad terminals, steam-heating plants and general engineering construction work. The officers of the corporation are: Lewis B. Stillwell, president; H. St. Clair Putnam, vice president and general manager; Hugh Hazelton, vice president; and W. Everitt Rundle, secretary and treasurer. The principal offices of the corporation will be at 100 Broadway, New York City.

T. J. WILKERSON has resigned as division engineer of the Department of Public Works, City of Pittsburgh, to accept the position of chief engineer with the Penn Bridge Co., of Beaver Falls, Penn. Since his graduation from Missouri State University in 1890, Mr. Wilkerson has been with several companies in designing, detailing and contracting for bridges, finally going with the Carnegie Steel Co., with which concern he remained until it was taken over by the American Bridge Co. In 1909 he was appoined assistant engineer and then in 1912 division engineer of the Department of Public Works, Pittsburgh, being in charge of designing, constructing and maintenance of all city bridges.

COL. W. H. HEUER, for many years a member of the California Débris Commission, in charge of rivers and harbors on the Pacific Coast, has been appointed division engineer for the War Department in California. Colonel Heuer had retired from Government service to engage in private practice in 1907, but again offered his services to the Government at the outbreak of the war.

HARRY W. KENNEY, who has been designing and estimating railroad structures for the Baltimore & Ohio R.R., has accepted a position with the Bureau of Yards and Docks, Navy Department, Washington, as draftsman on the design of structures pertaining to navy yards.

HARRY F. HARRIS, who for the past six months has been engineer of Mercer County, New Jersey, has resigned from this position to engage in private practice.

PERCY CUPPER, assistant state engineer of Oregon, has been made secretary of the Desert Land Board to succeed JOSEPH MCALISTER, who recently resigned to join the engineer regiment in camp at American Lake, Wash. Mr. Cupper will continue as assistant state engineer.

T. J. WRIGHT, until recently engineer of Benton County, Washington, has resigned and has opened offices in Seattle to engage in general consulting engineering.

W. D. CLARKE, formerly with the State Highway Commission of Oregon, has been named by the Public Service Commission to succeed E. E. MORELAND, resigned, as railway engineer for the commission.

WILLIAM CAMPBELL, professor of metallurgy, Columbia University, New York, is now serving as consulting metallographer at the New York navy yard.

NEIL W. FRENCH, formerly in charge of design and engineering for the Standard Reinforced Concrete Co., of Indianapolis, has recently taken charge of the same line of work for the Farris Bridge Co., of Charleston, West Virginia.

O. M. BUTLER, assistant district forester of the United States Forest Service, Albuquerque, N. M., has been appointed assistant director of the Forest Products Laboratory, Madison, Wis., and has assumed his new duties. Mr. Butler has been engaged in forest service work for ten years, principally in the West, where he was at different

times assistant forester in various districts.

FRANK E. WILMOT, who has been connected with the Bureau of Lands, Manila, P. I., as chief of survey, has entered the services of the National Coal Co. as assistant to the chief engineer and will leave Manila in charge of a party to make explorations and preliminary surveys for a railroad, wharves and coal lands in the Southern Islands of the Philippine group.

OBITUARY

PROF. HERBERT L. WARREN, head of the department of architecture, Harvard University, died suddenly June 27, at the age of 60 years. Professor Warren was born in Manchester, England, and studied at Owens College there and later at the Massachusetts Institute of Technology, joining the Harvard faculty in 1893. From 1886 to 1887 he was on the staff of the *Sanitary Engineer*, the predecessor of the *Engineering Record*. At the time of his death Professor Warren was a member of the firm of Warren & Smith. As a fellow of the American Institute of Architects, of which he was a director for three years, and as a member of the American Academy of Arts and Sciences, Professor Warren was much identified with the architectural development of the United States.

ZACHARY TAYLOR HERNDON died at Akron, Ohio, June 25, at the age of 71 years. Fifty years in the practice of his profession, mostly on surveys and construction of railroads, Mr. Herndon served as chief engineer during the building of many roads in the Western and Middle Western States.

R. J. MOSCRIP, civil engineer, died July 1 in Nashville, Tenn., at the age of 74 years. Up to within a few weeks of his death, Mr. Moscrip was actively engaged in his professional work. At various times connected with the Union Pacific and Missouri Pacific R.R., he was chief engineer of the Nashville & Knoxville R.R., now the Tennessee Central.

JUDSON C. CLEMENTS, a member of the Interstate Commerce Commission, died June 18 at his residence in Washington, D. C. Mr. Clements had been connected with the commission for 25 years.

JOSEPH V. KUNZE, vice president of the Pelton Water Wheel Co. and manager of its Atlantic department during the past 24 years, died in Brooklyn on June 27.

GEORGE WISHART CREIGHTON, for over ten years general superintendent of the Eastern Pennsylvania Division of the Pennsylvania R.R., died in Philadelphia June 2. Mr. Creighton entered the service of the Pennsylvania Railroad Co. in 1879 as rodman under Camille F. D'Invilliers, and later held the position of supervisor and superintendent of various divisions and sections of the Pennsylvania R.R. system, in 1899 being made general superintendent of the Philadelphia & Erie division and the North Central Ry. Upon the creation of the Eastern Pennsylvania division in 1907, Mr. Creighton became general superintendent, with headquarters at Altoona, Penn., holding this office until his death.

JOHN M. RUNKLE, for many years a contractor in Seattle, Wash., died in that city June 16. Born in Mercer, Penn., Mr. Runkle came to Washington in 1889.

WILLIAM A. STEVENSON, who has been the active head of the Norwood Engineering Co. since its organization, died June 7 in Florence, Mass., at the age of 57 years.

MELVIN RANDOLPH VAN KEUREN, civil engineer, died at Eatontown, N. J., on June 30, at the age of 62 Mr. Van Keuren studied engineering at Hasbrouck Institute, Jersey City, and completed his course at Cooper Institute, New York. For several years he was assistant in the engineering department of Jersey City. He later became resident engineer for the Pittsburgh, New Castle & Lake Erie R.R. He was afterward chief engineer of the Pittsburgh, Marion & Chicago R.R., and later built the Knoxville & New River R.R., becoming its chief engineer and president.

JAMES WHITFIELD WOOD died at his home in Easton, Penn., June 24, at the age of 72 years. Born in 1845, Mr. Wood was early connected with journalism, but in 1871 became connected with the Delaware Rolling Mills, and in 1873 formed the partnership of Tippett & Wood, boiler makers and iron-work construction, finally developing a business of building water towers, standpipes and tanks for railroads and municipalities. In 1886 Mr. Wood became president of the concern, which position he held until 1903, at that time retiring from active participation in business.

Engineer Officers' Reserve Corps Assignments

The following-named officers of the Engineer Officers' Reserve Corps are assigned to active duty and will comply with the following orders, issued under recent date:

First Lieuts. James W. Maitland, Paul McLoud and William T. Rossell, Jr., are assigned to the First Engineers, National Army, and will report to their regimental commander, Fort Totten, New York.

Second Lieut. John J. Callahan is assigned to the Second Engineers, National Army, and will report to his regimental commander, St. Louis, Missouri.

Capt. William L. Post and First Lieuts. Ernest D. Collamer, David E. Hayes and James H. Hustis, Jr., are assigned to the Fourth Engineers, National Army, and will report to their regimental commander, Boston, Massachusetts.

Capt. Clarence S. Coe and Second Lieuts. Harry G. Halleck and Robert L. James are assigned to the Seventh Engineers, National Army, and will report to their regimental commander, Atlanta, Georgia.

Capts. Clarence R. Rogers and Edward B. Whitman and First Lieuts. Alba B. Johnson, Jr., and William H. Stevens are assigned to the Ninth Engineers, National Army, and will report to their regimental commander, Philadelphia, Pennsylvania.

Second Lieut. Charles G. Brown, Jr., is discharged from his enlistment at the Engineer training camp, Washington Barracks, D. C., and assigned to the Ninth Engineers, National Army. He will proceed to Philadelphia, Penn., and report to his regimental commander.

Second Lieut. Barret Montfort is discharged from his enlistment at the citizens' training camp, Fort Benjamin Harrison, Ind., and assigned to the Sixth Engineers, National Army. He will report to his regimental commander, Washington, District of Columbia.

First Lieut. Schuyler M. Smith is discharged from his enlistment at the engineer training camp, Fort Leavenworth, Kan., and assigned to the Second Engineers, National Army. He will proceed to St. Louis, Mo., and report to his regimental commander.

Capt. Charles L. Joly is assigned to the First Engineers, National Army, and will report to his regimental commander, Fort Totten, New York.

Capt. Charles C. Cragin and Lieuts. Donald E. Rhivers and Walter C. Sadler are assigned to the Eighth Engineers, National Army, and will report to their regimental commander, American Lake, Washington.

First Lieut. Conway R. Howard is assigned to the Seventh Engineers, National Army, and will report to his regimental commander, Atlanta, Georgia.

First Lieut. James S. Hawley is assigned to the Fourth Engineers, National Army, and will report to his regimental commander, Boston, Massachusetts.

Second Lieuts. William E. Haberlaw and James W. Kern, Jr., are assigned to the Third Engineers, National Army, and will report to their regimental commander, Chicago, Illinois.

Capt. Joseph Caccavajo, Engineer Officers' Reserve Corps, is assigned to active duty and will proceed to American University, D. C., and report to the commanding officer, engineer training camp at that place, for duty and instruction.

First Lieut. Lawrence B. Glasgow, Engineer Officers' Reserve Corps, is relieved from his present duties and assigned to the First Regiment of Engineers. He will proceed to Washington Barracks, D. C., and report to his regimental commander.